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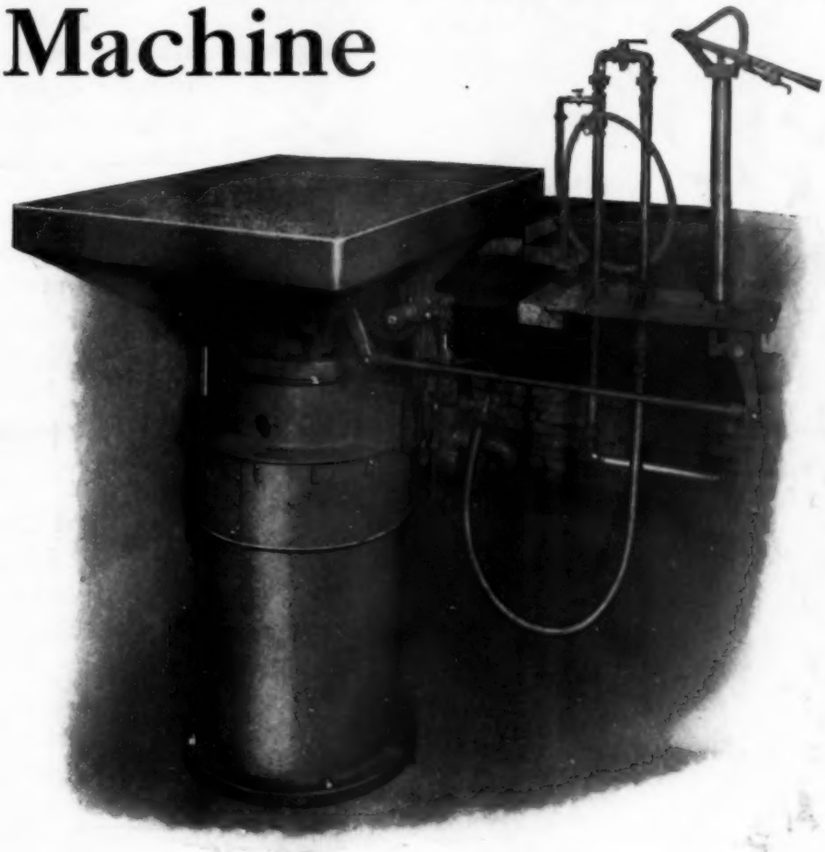

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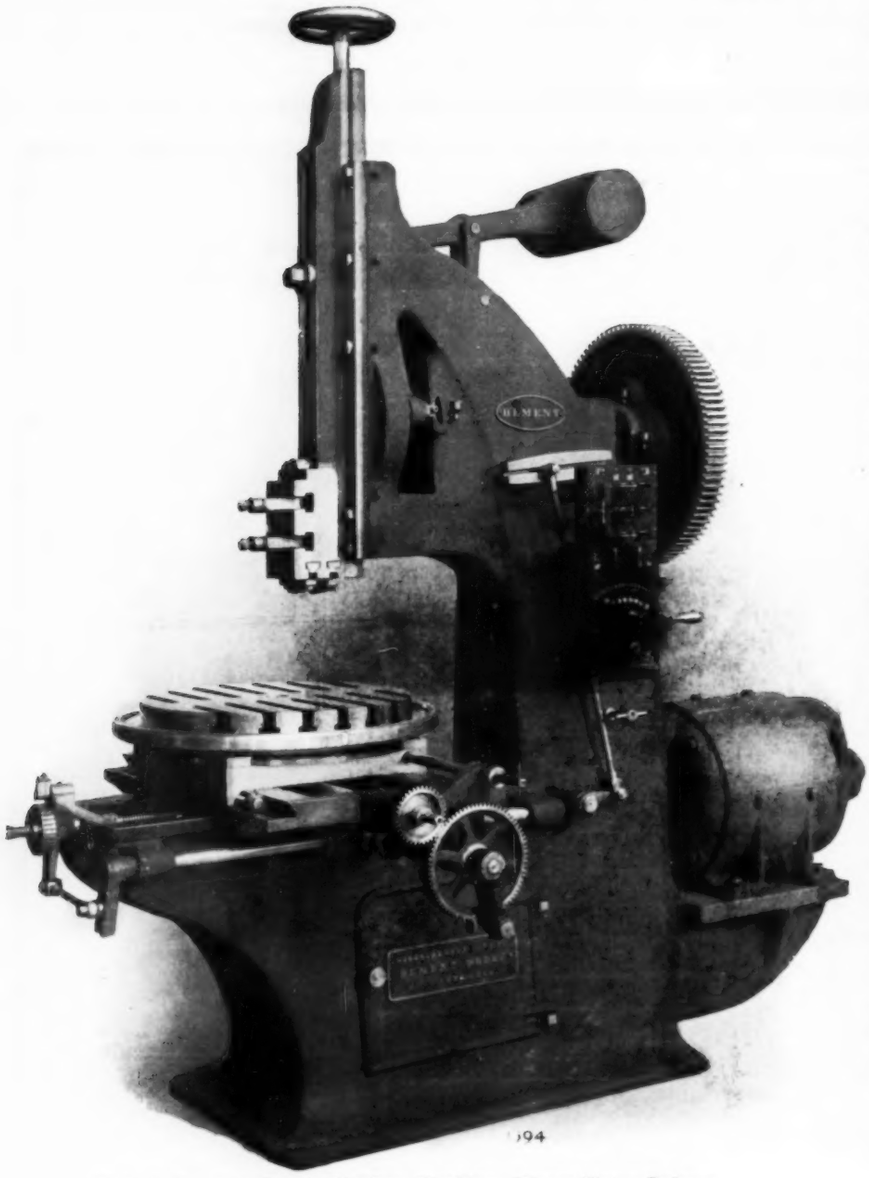

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(*See pages* 43, 44, 45, 46 *and* 47)

Training Mechanics in Germany*

By F. A. Halsey

Apprenticeship and not trade schools the means by which Germany's industrial army is trained. The word trade school has a radically different meaning in Germany and the United States and out of this a complete misunderstanding has arisen.

*In its preliminary form the manuscript of this article was submitted to E. Huhn, superintendent of the shops of Ludwig Loewe & Co., Berlin, and to Director Back, of the Industrial School of Frankfort a./M. The suggestions and criticisms made by these gentlemen have been incorporated in the article as it here appears.

Definition

The error, which it is the object of this article to, in some measure, correct, is the outgrowth of misunderstandings of terms and mistranslations of words, and in order to make impossible similar misunderstandings of this article, it is necessary to begin it with a definition of the term trade school. That term, as commonly understood in this country and as used here, means *a school intended to supersede apprenticeship, and which has for its main object the teaching, from the beginning, of skill and dexterity of hand.*

Difficulties of the Subject

To duscuss so large a subject as German methods in industrial education in the limited compass of an article like this is a difficult matter, for the reason that scarcely a statement of fact can be made to which exceptions cannot be found. Local practice varies so widely that general statements, although strictly true as expressing the practice of the country as a whole, will yet have exceptions, which may be cited and appear to disprove the statements.

I believe there are few subjects of inquiry in which it is so difficult to reacn correct conclusions, and of this the manner in which our schools have been misunderstood, even when the language difficulty does not exist, is a sufficient illustration.

Illustrations from Our Own Schools

I have before me a publication of the London County Council, containing the Report of the Section of the Education Committee, Appointed to Consider the Question of Apprenticeships, from which the following is an extract:

"A special feature is the close coöperation which exists in the United States between the employers and the trade schools. The managers of large industrial undertakings, many of whom were seen or communicated with, are practically unanimous in their praise of the beneficial results of the technical instruction. In many instances the only way of entry into the workshop is through the door of one or other of these institutions."

Remarkable as is this statement, its origin is easily traced from other portions of the report. It is the outgrowth of an impression, based on cursory examination that our schools of engineering are trade schools, and is a typical illustration of the difficulty of this injury, and of the worthlessness of many confidently expressed conclusions.

Again Mr. Mosely, well remembered as the generous provider of funds whereby the British educational committee was enabled to visit the schools of this country, has summed up the results of his observations thus: "The aim of education in America is to make every boy fit for some definite calling in life." The fact that it is possible for a foreign observer, who speaks our language as his own, thus to conclude that our schools are doing the very thing which, at home, they are universally criticized for not even attempting, shows in the strongest possible light the fundamental difficulties that surround the inquiry, and these are many times multiplied when a difference of language confronts the inquirer. Identical terms frequently convey different meanings in England and the United States and still more do German words and their literal English translations convey to Germans and Americans radically dufferent ideas.

The Misunderstanding Stated

Since, and indeed, long before the agitation for better industrial education in this country became acute, we have heard much of German institutions and methods in this field of educational work. Reports and papers have been prepared, dealing directly with these institutions and methods, while references to them in papers dealing with the general subject have become almost a staple. Out of it all and in ways which will be pointed out later has grown a fundamental misunderstanding.

This misunderstanding is that German boys as a regular and ordinary thing learn their trades in public, state or municipally supported trade schools. It is scarcely an exaggeration to say that many believe that the German boy or his parents first decide what trade he shall follow, and that he then goes to a public trade school to learn it.

It is perfectly true that in some industries, notably watch making and those devoted to artistic handicraft—wood carving, art smithing, pottery making, etc.—trade schools may be found. In artistic handicraft, however, the schools do not take the place of apprenticeship, but supplement it in a manner which will be described later and it remains true, that, so far as the constructive industries, in which American manufacturers are chiefly interested, is concerned, the impression described above is as far as possible from the facts. The broad truth simply is that neither the German Imperial Government, nor the local governments, engage in the teaching of trades. As a matter of fact, it is a perfectly safe statement to make that the teaching of trades in schools is practised to a many fold greater extent in the metropolis of this country than it is in the metropolis of Germany; that is, New York and Berlin respectively.

German Industrial Schools

Germany has a great system of industrial education, and because we connect the term "industrial education" with trade teaching, it has been assumed that the same connection exists in Germany, and that a system of industrial schools there involves a system of trade schools. Right here lies the fundamental misunderstanding of terms, which has already been referred to. There are others which are still more to the point, and which will will be explained later, but this fundamental misconception makes it necessary to explain just what the German government through the municipalities does in the direction of industrial education—industrial education being understood to mean education for the industries, and not to include professional education in engineering, which in Germany, as is well known, has reached a magnificient stage of development.

The Continuation Schools

Broadly speaking, there are, in Germany, two classes of industrial schools, the first being the continuation schools, of which we hear so much. Attendance upon these schools is compulsory on the part of all boys below the age of 16 or 17, who are serving an apprenticeship in a commercial workshop, or office, the requirement varying with the locality. The number of hours of school work required is a minimum of four and a maximum of six per week. The subjects required to be taught are the German language, computation and drawing, arranged especially to supplement the workshop training. The limitation of compulsory attendance at the age of 16 or 17 really implies two or three years of this work. Boys are released from the full time public schools at the age of 14, and they commonly enter upon their apprenticeship at once. The work of the continuation schools is done chiefly during the evening, although

partly in the day time and partly on Sunday—in some cases Monday being devoted to the work. There is a decided tendency toward week-day work, growing out of the feeling that evening-school work requires too much of the boys. Even at present the school work cuts into the shop work to a considerable extent, as the employer is required to release the boys from the shop at an hour which will permit them to go home, make themselves presentable, eat supper and get to school at 7 o'clock; in some cases as early as 5 o'clock. The employers are also charged with seeing to it that the boys do attend the school—a requirement which, in the case of shops employing many boys, is found to be distinctly onerous.

The Meaning of Industrial Education in Germany

The above will show better than any amount of explanation what is meant in Germany by industrial education. It means education chiefly, and usually wholly, of an intellectual character, but relating to particular trades or industries. It does not mean, primarily, the teaching of manual skill and dexterity.

The Improvement Schools

The second class of schools is of a more advanced character. As the continuation schools supplement shop work during apprenticeship, so these schools supplement it after apprenticeship. Provision is made for day, evening and Sunday work, and the student may, and frequently does, leave the shop for a time and devote his entire time to work in these schools. Unlike the continuation schools, attendance is purely voluntary, and, in fact, a small fee is charged. Before admittance the student is required to have served a regular term of apprenticeship. The schools are called by a, to us, curiously misleading name, which more than any other one thing is probably responsible for the prevailing misunderstanding. As I write I have before me the *Programm des Stadtischen Gewerbesaales zu Berlin;* literally, Program of the Municipal Trade Schools of Berlin, and among the schools described in the pamphlet, I find *Die Fachschule fur Maschinenbauer;* literally, The Trade School for Machine Builders.*

The Meaning of Trade School in Germany

No one can be criticized for supposing at the outset that these words refer to trade schools as that word is used in this country. That such an understanding is entirely erroneous is, however, shown at once by the schedule of studies followed in The Trade School for Machine Builders, which appears in the section devoted to that school, as follows: Mathematics and mathematical exercises, physics, chemistry, technical mechanics, machine elements and machine study, properties of materials and tools, electrotechnics, general and mechanical drawing. Here again we have an exhibit which shows more clearly than any possible explanation what is meant by the term "trade school" in Germany, namely, a school chiefly, and usually wholly, of an intellectual character for those who are learning or who have learned a trade.

An inquiry regarding the existence of trade schools in Germany will invariably be met with an affirmative answer. The inquirer will be told that they exist everywhere, and the statement will be a true one from the standpoint of the man who answers the question—that is, from his understanding of the meaning—but the answer conveys a wrong understanding nevertheless. So foreign is our idea of a trade school to German educators that I had great difficulty in making myself understood and, in fact, after the most painstaking statement that I wanted to see schools teaching manual work only, I was, at first, sent to one that did no hand work whatever.

Mistranslation of still another German word has contributed its share toward the prevailing misunderstanding, this word being *Handwerkerschule;* literally, hand-worker school, which may be very easily understood as meaning a school of hand work, whereas, in reality, it means a school for hand workers.

This word was chosen 30 years ago, long before the origin of the idea of including trade teaching in school work. If the facts were known, it is not improbable that they would show that trade schools were established in this country quite as early as elsewhere and that their present development here is as great, as if not greater, than in Germany.

Manual Improvement Schools

The schools now under discussion are, as nearly as I can determine, those which in various reports on the German educational system are called improvement schools—a term which exactly describes their function. In certain cases these improvement schools are of an exclusively manual character. I was able to find one such school in Berlin, which I was assured was the only one in the city. I found in one room a complete machine shop with work being done appropriate to such a shop. The equipment of a second room was quite similar, except that the tools were of lighter character and adapted especially to instrument making, which was the work there done. A third room was equipped with small forges and and other equipment of a light blacksmith shop, the work in progress being art smithing.

This school offers, perhaps, the best opportunity of all for radical understanding. To all outward appearances here was a school teaching the trades of the machinist, the instrument maker and the art smith, but inquiry soon developed the fact that this also is an improvement school, although on manual instead of intellectual lines. Before a student can be admitted he must have completed an apprenticeship, the object of the school being to provide opportunities for obtaining experience and practice on classes of work different from those which the student has followed in the commercial shop.

While of high character, the school is of modest dimensions, each department having 14 places, or a total of 42 places for the entire school, and the 42 men who occupy these places represent the total training in manual skill and dexterity carried on in the public schools of the city of Berlin.

Absolute accuracy requires a modification of this statement. The work of this school covers a definite period of time, a class of students entering and leaving it together. The entering of a class of students in this manner, none of whom is familiar with the shop, leads, of course, to confusion and loss of time until this familiarity is acquired. In order to diminish this and have a small force constantly present who are familiar with the shop, it has been found advisable to take on two lads as apprentices in each department, and to keep them there for the regular apprentice period of four years. As regards the city of Berlin, we thus find that the residue of truth of the bottom of the prevailing belief is that that city has a total of six lads in training as mechanics.

In point of numbers the manual improvement schools are much less important than the intellectual improvement schools which are far more numerous. Of these latter, especially, I formed a high opinion, based largely on reports of the experiences of manufacturers with their graduates, who, to a large extent, fill positions of responsibility in the shops. They select the wheat from the chaff by providing a means of education for the ambitious and energetic and their influence is far reaching. So far, however, from being trade schools as they have been understood to be, their effect is to educate men out of the shop ranks instead of into them.

Monotechnic Schools

These improvement schools frequently pass by insensible gradations into high-class technical (monotechnic) schools devoted to particular local industries. In them workshop and theoretical instruction are often combined, very much as in our engineering schools, though in fields of work which we have scarcely thought of including in school work. Their aim is

*The two words *Gewerbesaal* and *Fachschule* express a difference of meaning which is scarcely translatable into English, the meaning of the first word being somewhat broader than that of the second. In view of the contents of the pamphlet both can here be understood as referring to trade schools only.

still, however, far removed from the supply of workmen for the factories.

The broad difference between the German and our own system of vocational education lies in the recognition in Germany of the intellectual and scientific side of a large number of industries where we have not yet recognized it. We have recognized it in connection with the machine-building industries but scarcely in others and the spirit of our engineering schools is precisely the spirit that Germany has carried into many other fields of work. The most painstaking and detailed inquiry into German industrial school work that I have seen is contained in the various reports of Dr. Frederic Rose,* which relate largely to schools of this character. In many cases previous workshop training is not required, but an examination of the schedules of work will show that the students entering the schools can have little expectation of becoming workmen at the bench. Illustrations could be given to an extent that would exhaust the reader's patience, but I will content myself with three.

The Work of German Monotechnic Schools

The mere statement that there exists at Lichtenfels, Bavaria, a basket maker's school would prove to most trade-school advocates that here is a trade school. As a matter of fact it illustrates the German recognition of the intellectual side of the basket-making industry, as shown by the following schedule of studies: German language and commercial papers, grammar, reading, correct writing and calligraphy, industrial calculations, industrial bookkeeping, history of industry and basket weaving, freedom of industry, organization of chambers of commerce and industry, industrial legislation, communities, social and economic arrangements, constitution of state and empire, geometrical drawing and elements of the theory of projection, freehand drawing, technical drawing, workshop instruction, including knowledge of materials, tools and appliances, and the cultivation of osiers.

Of greatest immediate interest to the readers of this paper is the report of Doctor Rose on "Technical Schools, for Special Branches of the Metal Industries," in which he gives, with others, the schedule of the school for the metal industries at Remscheid as follows: German, business matters, common calculations, freehand drawing, algebra and geometry, descriptive geometry, mechanics, physics, chemistry, metallurgy, mechanical technology, linear drawing, machinery, machine drawing and design, sketching, building construction, architectural drawing, electrotechnics and workshop instruction.

*Assistant educational adviser to the London County Council, formerly British Consul at Stuttgart.

The workshop instruction in this school covers a larger portion of the total time than in most others, being a little less than one-half. That the school is not, however, intended to fit its students to follow any particular trade is shown by the scope of the workshop instruction, which includes blacksmith work, chipping, filing and fitting, the foot and engine lathe and other machine tools, polishing, metal stamping, hardening, galvanizing, carpentry, wood turning, grinding, tinsmith work, lacquering, engine and boiler management and molding and casting. In this and other cases the shop work appears to be entirely of the exercise character.

Of all these illustrations the department of locksmith work at the Nuremberg Building Trades School is, perhaps, in connection with the name of the school, the most striking. Following is its schedule: German, calligraphy, arithmetic and algebra, planimetry, stereotometry, descriptive stereometry and shading construction, freehand drawing, forming, shaping, beating out, mechanical engineering, special technical drawing, elementary natural science, forces, strength of materials, trades and handicrafts, iron constructions, firing and fuel, building materials, industrial bookkeeping.

Of other illustrations that might be given are those of schools for the tanning and textile industries, of photography, milling (of flour), musical instrument making, glass making, pharmacy, the building trades, printing, clock making, sheet-metal work, gas fitting and plumbing, the bare names of some of which convey almost irresistibly the impression of trade schools until the schedules are examined.

All this, of course, shows a wonderful educational development but, turn whatever way we may, provided we get below the surface, we find the work to be, if not entirely, then chiefly of an intellectual character and intended to fit men for positions of leadership. In but few cases does the manual work occupy any considerable portion of the time, and in still fewer is it reasonable to suppose that the schools are attended by those who expect to earn their living with their hands. They are schools of technology, not of technique. Their relation to the industries which they represent is essentially the same as that of our schools of mechanical engineering to the building of machinery.

How Mechanics are Trained in Germany

The reader, has, perhaps, by this time formed a correct conclusion of the real way in which mechanics acquire their trades in Germany—namely, through the old-fashioned system of apprenticeship, which there maintains its full force and vigor. If German shops are better supplied with skilled workmen than American shops, it is because of this system of apprenticeship and not because of the educational system. That the educational system increases the intelligence and understanding of the workmen goes without saying, but it does not increase their number, nor does it increase their skill and efficiency, except in an indirect way through the cultivation of their intelligence. If we are to copy from Germany, then, in the teaching of manual skill and dexterity, there is nothing for us to do but get back to the old-fashioned system of apprenticeship.

In Germany it is still the proper thing for a boy who has his living to earn to learn a trade and to do it in the old-fashioned way, and there is hence, so far as numbers go, no dearth of applicants.* While there are plenty of exceptions, most German employers take apprentices as a matter of course, and the condition which is at the bottom of the demand for trade schools here does not exist there. The fundamental condition here is a scarcity of apprentices, while the corresponding condition there is an abundance of them. Here the problem is to attract boys to the shops while there it is to educate those already in the shops.

The Nature of Apprenticeship in Germany

This German system of apprenticeship is a serious thing, and not the loose-jointed affair that goes under the same name with us. Apprenticeship papers are a contract binding on both parties and one which neither can break except for the most serious reason, although it may, of course, be dissolved by mutual consent. Apprenticeship commonly begins at the age of 14, which marks the close of the compulsory full-time school period. According to American ideas, this age is, of course, too young. The term of apprenticeship varies between three and four years. At the same time, the plans for abbreviated specialized apprenticeship and for training men of mature years as operators of special and automatic machines, and without the signing of apprenticeship papers, are in full operations.

The Trouble of German Shops

It is impossible not to be impressed with the fact that every phase of the subject which excites so much discussion among ourselves exists also in German shops, although, of course, not to the same degree in all cases. The plans for abbreviated apprenticeship and for the training of operators are illustrations in point.

While there is little or no difficulty growing out of the quantity of apprenticeship material, there is the same complaint

*With the possible exception of the foundry, where conditions seem to be tending toward those which are common with us, though from different causes.

about its quality. There is the same feeling among workingmen that the shop offers no adequate field of promise and this leads, in some sections at least, to a scarcity of superior boys.

There is the same doubt regarding the profitability of apprentices, and some shops, believing them unprofitable, refuse to take them, and then recruit their forces from men trained elsewhere—and they are no better liked for doing it than similar shops are here. There is the same restlessness of apprentices and a desire to go elsewhere after their term of apprenticeship is finisned, this condition being, apparently, quite as acute as with us. I was told of one shop in which figures kept for several years showed an average figure for those who remained of only 11 per cent. and of another in which the percentage was 14. There is the same disposition among boys to seek positions as errand and messenger boys, elevator operators, etc., and for the same reason—larger immediate wages. There is among German employers, the same feeling of dissatisfaction with existing methods that we find at home. German employers are beginning to ask if the old method of distributing the boys around the works with no provision for deliberate teaching cannot be improved, and they are beginning to answer it as Mr. Alexander has answered it at West Lynn and Schenectady, by grouping the boys in a training room under competent instructors. They are also beginning to recognize that illustrations drawn from their own work can be made a better basis for class-room work than anything that the public continuation schools can give, and they are beginning to establish shop class-room schools similar to those established by Mr. Alexander, the work being done during shop hours.* Attendance at such a school, provided it has received the necessary official certificate, excuses an apprentice from attendance at the continuation schools.

True, these movements have not gone very far, but neither have they with us. They serve, nevertheless, to give pause to the idea that the German employer lives in a paradise, so far as a sufficient supply of adequately skilled help is concerned. German shops have, too, their labor troubles and serious ones. The idea that compulsory military service leads to habits of unquestioning obedience is a long way from the truth.

Schools of Artistic Handicraft

Mention has been made of the fact that in towns whose industries are based on artistic handicraft schools are found which approximate more closely to the American idea of trade schools. Even these schools, however, act as a supplement to and not as a substitute for apprenticeship. In artistic industries far more than in others, an apprentice is under commercial condition, which make it impossible for an employer to adequately train him in all phases of the work. In the development of his artistic sense, in the practice of drawing and design and in other directions there is in these industries a large field of work appropriate to the schools and beyond the financial capacity of the employers to provide. Apart from the fact that we have few industries of this character, these conditions are peculiar to them and the school work done in connection with them furnishes no precedent for the constructive industries.

To sum the matter up, while local exceptions can be found, the broad fact remains that the German government does not undertake to relieve the manufacturer of the burden of training his own workmen in handicraft. That is entirely foreign to the German educational system, which concerns itself, primarily, with the intellectual and not the manual training of future German citizens.

All this is not an argument against trade schools and it is not offered as such, the facts cited proving nothing against the trade-school idea. What they do do is to cancel the conclusion that trade schools are by German experience a proven thing. If trade schools are a practicable thing, the fact remains to be proven instead of proof, based on supposed German experience, being taken for granted. In so far as we are doing anything with such schools we are blazing a new path.

*Our next issue will contain an article on the shop school of Ludwig Loewe & Co., of Berlin.

Planer Converted into a Grinder

Converted tools are always interesting. The present example is of a planer converted into a flat grinder, and in use in the Waterbury Farrel Foundry and Machine Company, Waterbury, Conn.

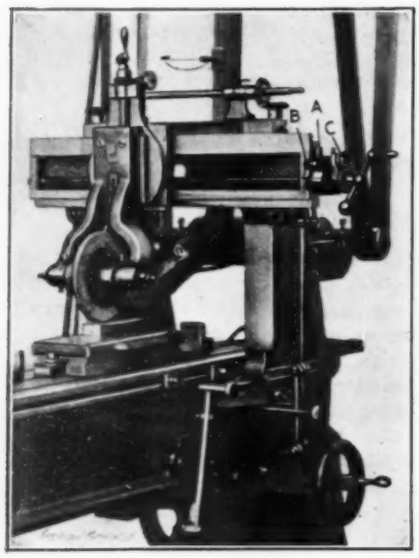


Fig. 1. Planer Converted to Flat Grinder

As will be seen from the halftone, Fig. 1, a special yoke, taking the place of the head, carries a grinding wheel, which is driven by a belt coming from the wide pulley behind, thus allowing for cross travel of the wheel.

One of the interesting features is the method of providing cross feed of the grinding wheel at the end of each stroke of the platen. To secure this the yoke *A* (also shown in Fig. 2) has two sets of rack teeth cut on the inner surfaces of its straight top and bottom sides. One of these racks is on, say, the left bottom side of the yoke and the other on the upper right. Mounted upon the feed screw are two loose gears, one meshing with the lower, or left-hand rack of the yoke, and the other meshing with the upper, or right-hand rack. Then, as the yoke is traveled back and forward by the shifting mechanism of the platen, the two gears revolve on the feed screw in opposite directions, because one rack is above on one wheel, and the other is below, meshing with the other wheel.

The two wheels carry reversible pawls *B* and *C*, which drive ratchets keyed to the feed screw. Both pawls, of course, are set for, say, forward motion of the feed screw, and when the rack yoke moves forward, that wheel which is thus turned forward drives the feed screw forward, while the wheel which is turned backward by the opposite rack of the yoke carries its pawl backward over its ratchet. Upon reversal of the motion of the rack yoke, when the platen next reverses, the motions of the two wheels meshing with the racks are mutually reversed, and the now forward-turning wheel gives the feed screw another forward motion, while the other turns idly backward.

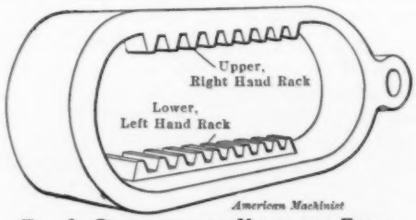


Fig. 2. Double-rack Yoke for Feed Mechanism

If desired, either pawl may be disengaged, and all the feeding done by one side of the rack and one wheel, thus feeding only every other stroke, as with a planer.

Repairing a Broken Anvil Block

By John Miller *

A case in which resourcefulness saved a lot of time. A new field for electrically driven machine tools.

*Foreman millwright, the General Electric Company.

One of the least important departments in the modern machine shop or manufacturing plant, and one that is considered only as an expense, and a good thing to be kept down as much as possible, is that generally known as the repair gang, and yet a great deal of useful work is performed by the same despised gang, who are usually found in the most poorly equipped shop in the plant. While given no special facilities for their work they are called upon to repair breakdowns which would tax many departments which are much better equipped.

In an uptodate manufacturing plant, where the machinery is pushed to the utmost, it frequently happens that a breakdown will affect several departments, holding up the production and causing a general howl all along the line. This is the only time the repair gang have a chance to shine. The manager or superintendent, whose time is generally very much taken up by the executive business of the company, sends for the boss of the repair gang and in no uncertain tones informs him that the repairs must be attended to at once, as production is being held up for lack of material which comes from the machine that has broken down. It is at such times that the latent abilities of some of the repair gang come to the front and show what can be done in times of emergency.

The following is one of these cases which recently happened at the Schenectady plant of the General Electric Company when one of the dovetails on the anvil block of their large 6000-pound steam hammer broke off. The construction is such that to remove the broken anvil block would have necessitated dismantling the hammer which would have been quite a job. The boss millwright, however, conceived the idea of repairing the same in place. The manner in which this was accomplished is shown

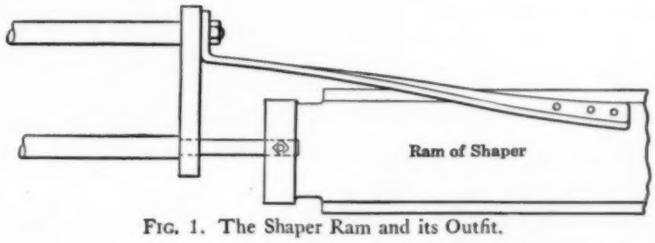


FIG. 1. The Shaper Ram and its Outfit.

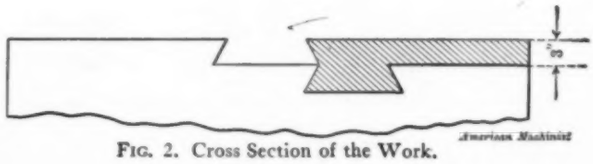


FIG. 2. Cross Section of the Work.

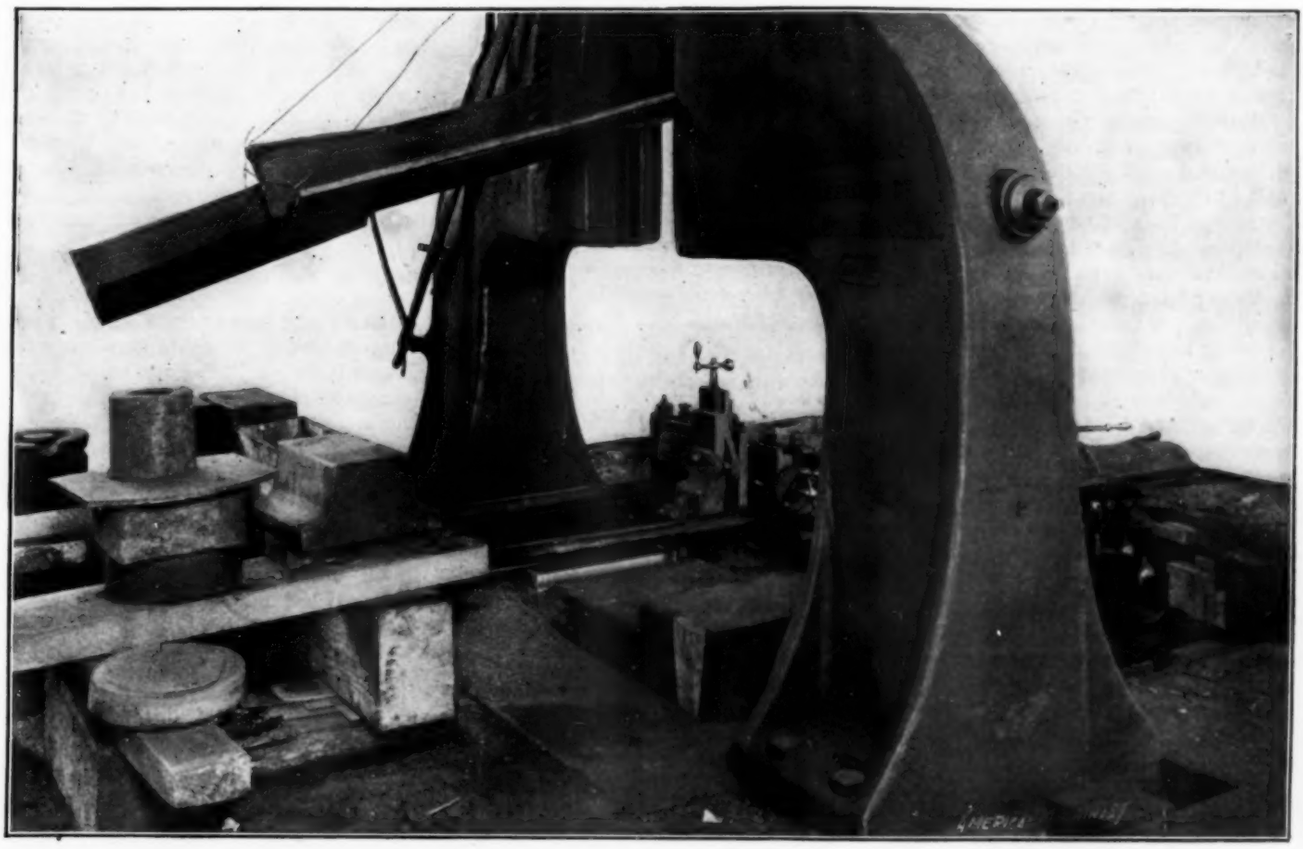


FIG. 3. VIEW OF THE RIG

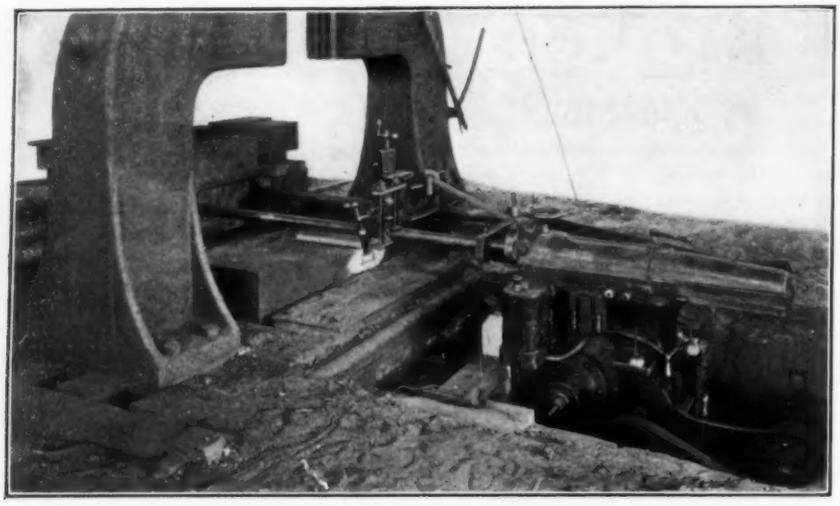


FIG. 4. READY FOR WORK

very clearly in Fig. 1, and also by means of the photographs which were taken at the time. As can be seen, a hole was dug alongside of the anvil block large enough to permit the placing of a 24-inch motor-driven shaper, which was securely blocked in place. The clapper box on the end of the ram was removed and a 2½-inch diameter bar was turned to fit and was driven into the bolt hole used for securing the clapper box. This rod was further secured by means of the set screw shown. A similar rod was placed parallel to this and firmly secured to the ram; while the other ends of the rods were inserted in holes bored in a 10x12-inch pine timber that served as a guide and as shown by the halftones, was anchored in place by means of slabs of steel, anvils, etc. The tool for doing the work was carried on the cross rail of a small planer, which was securely fastened to these two round bars, the feeding being done by hand.

By reference to Fig. 2 it will be seen that the amount of material removed, shown by the shaded portion, in order to effect the repair was considerable, being about 22x24x3 inches, in addition to a dovetail slot 3 inches deep by 4 inches wide and 22 inches long. When this had been accomplished a cap piece, which had been made elsewhere, was placed in position and keyed in place.

The entire operation for making the repairs covered about 50 hours, while if the hammer had been taken apart it would have required about two weeks.

The job also shows one of the advantages of motor-driven machine tools, as it was only necessary in this case to drop the machine and motor, which were self-contained, into the hole, block or wedge it in position, connect a single wire with the trolley wire, and ground the other wire on one of the rails of the railroad track, no change in the connections of the controlling apparatus being needed.

Why Machines Do Not Make Good

By John R. Godfrey

The success of a machine depends more on the operator and on the methods than most of us imagine.

It pays to see that the operator understands the machine and to have him know that he is considered as a human being instead of part of the machine.

The success of a machine depends as much on the way it is used, as on the way it is built. Many makers of good machines know this to their sorrow.

Probably every manufacturer of machine tools, whether he likes to admit it or not, can recall instances where his machine has never given complete satisfaction. Not from any fault of the machine itself but from the ignorance or opposition of someone connected with its use.

Many a good machine is not turning out nearly its full quota of work, because the operator knows from experience in that particular shop, that if he does not hold back the production his rate will be cut at once. And he doesn't propose to be executioner at his own funeral. So, through no fault of the machine or its builder, the output is never what it should be.

In other cases the foreman or someone in charge had specified a certain make of machine and another make has been forced on him instead. It may be a better machine but he is apt to be just human enough to dislike helping to show that his judgment was poor in selecting some other tool. And the lucky (?) machine that was chosen has to suffer. Of course, it isn't ethical but it's awfully human.

Then too, it may be (though I believe these cases are rare) that someone had a slight financial interest on the side in the sale of the other machine, and the successful rival has all kinds of obstacles thrown in its way.

WHEN THE MAKER DOESN'T KNOW

The worst of it is that the maker doesn't always know that his machine isn't doing well. Or perhaps it is just running and being "damned with faint praise" to every visitor who comes in the shop. How often we hear something like this: "Oh yes, it's a fair machine, but it doesn't show half they claim for it in their ads."

The chances are that it isn't being run at the right speeds or feeds, or even on the work that it was bought for. The demonstrator often finds that after he has started up a machine and left it going in good shape, the whole routine is changed as soon as he leaves the shop. Sometimes this is through an honest belief that another way was better but more often through pure cussedness in the mind of some disgruntled foreman or operator.

And this is the hardest thing in the world to combat, because the operator is always on the job and because the average shop rarely finds out that there has been an increase in the cost of a certain piece until it is about ready to change the model for some reason or other.

DON'T OVERLOOK THE MAN "LOWER DOWN"

Now to my way of thinking, this shows that the selling or educational campaign wants to include the operation as well as the purchasing agent. "You can lead a horse to water but you can't make him drink," as the old saying goes. So you can buy a machine and tell the operator to run it this way or that. But it sometimes costs more to make him do it than the increased output amounts to.

Of course, you can fire the operator but the next one may not be any better—and your work is waiting.

I know a man who attributes much of his success to his treatment of office boys in the offices he visited in the early days of his business. He didn't hand out quarters or base ball tickets or bribes of any kind, but he did treat them just as though they were real human beings instead of just office boys. Many of them are now in charge of the business he sells to, and they don't forget it.

In the same way I believe that many machine tools would be doing a great deal better work and be more of a credit to the builders, if the operator had been considered as a human factor instead of part of the machine.

This is more often the fault of the shop using the machine than of its manufacturer, but unfortunately they are not the only losers.

It will pay to impress the operator with the fact that you have considered his comfort in putting all the controlling handles where he can readily reach them and in such a way that he will not get caught in the handles. That the rapid power traverse saves him a lot of hard, useless labor, and last but not least, that, instead of being a scheme to squeeze his pay envelop, it will enable him to produce more with the same effort and earn a little more money.

In other words, the complete success of any machine in a shop is the hearty cooperation of all who have to do with it, just as the success of any business depends on the working together of its different departments and, although this is generally acknowledged, it cannot be emphasized too often.

Making Hindley Worm Gears

By Charles H. Logue

An experience in cutting Hindley worm gears that showed the points of interference. Efficiency of worm gears is effected by grinding, and grinding is strongly advocated.

Much has been written that has thrown light on the peculiarities of the Hindley worm gear, notably by Oscar Beale and Mr. Brown. I believe, however, that my experience with this gear will assist in making the matter clearer.

For the first attempt a hob was made an exact duplicate of the Hindley worm, no clearance being allowed at the points of the teeth, as the worm tooth is supposed to bottom in the tooth of the gear. When this hob had entered the gear but a short distance it was evident, if indications mean anything, that the gear teeth would be entirely cut away by the action of the hob. Right here is where we should have suspended operations and found out what we were up against, but instead we supposed that the end threads of the hob had been distorted in the hardening and they were removed.

Before the hobbing of the gear had proceeded much further, the same condition was again apparent and more threads were removed from each end of the hob, until, finally, the hob consisted of but a single thread. The gear was finished with the hob in this condition and, of course, the worm would not enter—it would hardly lie on the top of the gear. After this experience a fly cutter was used to cut the gear, set to the mean radius of the worm. This apparently would cut the gear teeth to the mean angle of the worm and the worm would have some chance of entering the gear. But this gear was little better than the first "attempt"—something else was wrong.

The next step toward a solution was due to an accident. "Squatting" one day before one of the unsuccessful gears, I happened to lay my rule along the tapered side of the gear face on line with the axis. This projected line resembled the back cone radius of a bevel gear—the projection from the pitch line of the gear to its intersection with the gear axis representing a spur gear of that radius engaging a circular rack, the rack being the worm. As this "side radius," as it might be called, is constantly shortened as the central section of the gear is approached, and the number of the teeth in the gear is constant, the pitch of the teeth must change with the side radius if a full bearing is to be obtained, also the worm thread must be made to suit—which is likewise impossible. Then again the diameter and direction of the circular rack is constantly changing. Therefore, a Hindley worm gear having full contact on all of the teeth, or even on *one of the* teeth is an absolute impossibility, and not to be expected. See Fig. 1.

After considering these points it seemed to me that a passable set could be made by chasing the worm to correspond to the mean side radius of the gear, thereby increasing its pitch to the mean pitch of the gear, and cutting the teeth in the gear with a hob in which the finishing teeth were set at the mean radius of the worm, or by a fly cutter as described. The worm was chased by a number of tools set radially on a plate, as described by Mr. Brown, a single tool being used to finish as the worm was single thread. These tools were set according to the mean side radius of the gear, the thickness of the teeth corresponding to the pitch at the minimum gear radius. In this manner we secure the average angle of the worm in the gear teeth and the average pitch of the gear in the worm thread. These gears when finished would very nearly go full depth and a little grinding with powdered glass and water made a very creditable job—much better, in fact, than may seem.

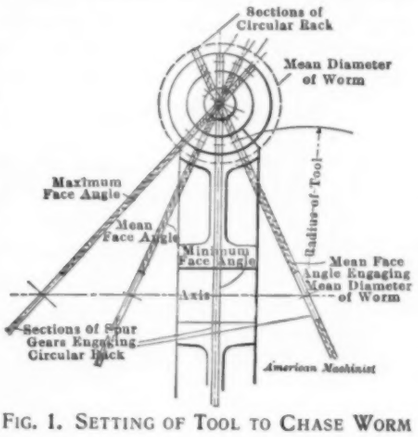


FIG. 1. SETTING OF TOOL TO CHASE WORM

There are several points about a Hindley gear that must be approximated. So far as this experience teaches they are as follows: The diameter of the circular rack, represented by the worm is constantly changing. This effects:

First, the angle of the worm thread which varies, while the angle of the teeth in the gear which it must engage remains constant.

Second, the thread radius and the circular velocity vary with the diameter of the worm.

Also, the pitch of the gear must vary to properly engage the worm clear across its face, and the width of the tooth space must, at the same time remain constant to suit the thickness of thread in the worm.

Practically we may have, perhaps, a full bearing on one tooth and a small bearing on the balance. This is undoubtedly more contact than can be obtained in the ordinary straight type of worm gears, but what kind of contact is it?

To secure this additional contact, of doubtful value, we must have no axial, or end movement of the worm. This, in addition to the necessity of accurate side adjustment, makes a very difficult gear to install. Many have found the straight type hard enough, but the Hindley worm must be held absolutely stationary in one spot, no adjustment or wear is allowable in any direction. If the worm is given any end play whatsoever, it immediately tries to climb up the side of the gear and makes a very effective brake. A Hindley drive would be in no danger of dropping its load, no matter how steep the thread might be, if thrust bearings were provided at but one end of the worm.

EFFICIENCY OF WORM GEARS

We all have seen tests of the efficiency of the Hindley worm gear offered in comparison with the efficiency of the regular type and were rather impressed with the superiority of the Hindley type. I would like to put myself on record as saying that if the straight worm gear had been as carefully ground into mesh as the Hindley gear, no such difference would be shown. A straight-line worm gear is in no condition for active service

when first cut, the hob does not cut a path that the worm thread will follow. The worm must find its own bearing, and the surface of the teeth must have attained proper finish before real work can be done. This accounts for the many failures and supposed low efficiency of these gears. For this reason the worm should always be hardened and the threads polished, as the teeth in the gear are then sooner brought into the proper condition.

I had an experience with a straight worm gear that will illustrate the necessity of grinding the teeth. The worm gear was made of 0.35-carbon cast steel, 1-inch pitch, 3-inch face. The worm was 1-inch pitch single thread, 3¾ inches pitch diameter, of 0.20 carbon steel and case hardened. The circumferential speed of the worm was 300 feet per minute. It was found that these gears would not drive the machine at full speed. As soon as a speed of about 100 feet per minute was reached, the gears would freeze fast, even when driving the empty shaft with the bearings loosened. It is possible that if this speed (100 feet per minute) was not exceeded that the gears, apparently satisfactory, would have worn out in short order, and straight worm gears would have received another black eye. On the other hand, it might have happened that the proper bearing surface would have been eventually obtained, but this should not be left to chance. It is apparent, however, that tests made for worm-gear efficiency should be made with properly ground gears.

The gears in question were run at a slow speed for several hours in a bath of light oil and graphite, after which the full load was applied. These gears have now been in operation for three years, running dry, and show no sign of wear; the teeth having a smooth hard surface.

Spiral gears are subject to very much the same conditions—the efficiency is low unless the proper tooth surface is obtained and high speeds are impossible. I have seen spiral gears that had started to wear rapidly that were saved for a long period of service by the application of a file, followed by an oil stone upon the worn teeth. The query of a gas-engine manufacturer will throw some light upon this. He said: "Why is it that some of our spiral gears are perfectly satisfactory and show no evidence of wear while others wear right out? Why I have seen them go down in exactly eight minutes?" The fact of the matter was that some of the gears did not happen to get started right and therefore wear rapidly. Would it not be a good idea to grind in all such gears in a frame duplicating actual conditions as far as possible, but at a light load?

It is not advisable to grind the teeth of spur gears in this manner, as there is sure to be a flattening of the teeth along the pitch line, especially if pressure is used to force them into mesh. The involute tooth does not tend to maintain its true contour under these conditions. Spur and bevel gears should be ground, but with a hardened pinion two addendums in diameter larger than standard. This will locate its pitch line at the bottom of the tooth, and as the pitch line of this pinion cannot roll upon the pitch line of the gear to be ground, therefore there can be no rolling action between the teeth. Another method by which the engaging gears can be put in shape for service is to first engage them so that the teeth are just engaged. Then to slowly draw the centers together until the proper distance is reached, and repeat the operation. Also it is well to give one of the gears an end movement on its axis, so that the entire face contact will be uniform. This is to be especially recommended for large cast-tooth gears, as high spots may be removed and errors corrected as soon as they come into contact. Many large cast gears have been destroyed before ever performing any actual work by thick teeth or high spots.

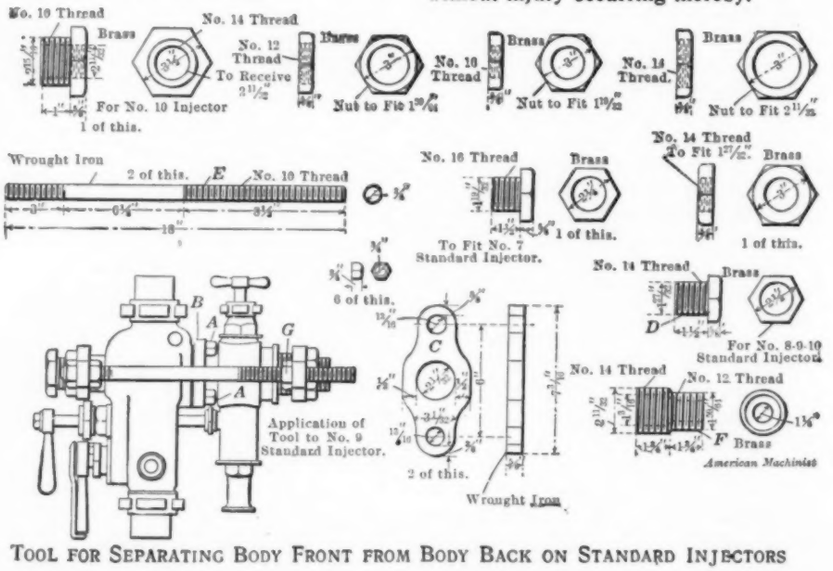
As the condition of the teeth has such a decided bearing upon the efficiency, especially for high loads, I am curious to learn the condition of the teeth in the gears used in the tests recently made and referred to in Wilfred Lewis' article on Interchangeable Involute Gearing; page 305; especially the condition of Mr. Bilgram's sample gears, which I would hardly consider as a fair representation of the work of the Bilgram machines. The increased pinion addendum should result in increased efficiency unless this theory is at fault. My reason for not considering them fair samples is that for low numbers of teeth with increased addendum, there is almost sure to be flats upon the teeth unless an extremely fine feed was used. Were these flats apparent? These same flats are to be found when cutting low numbers of teeth on the Fellows shaper. On a nine-tooth four-pitch gear they are sometimes one-eighth of an inch across and very noticeably in a 12-tooth gear.

Tool Used on Locomotive Injectors

By W. J. Shadle *

The line cut shows a successful method used at the Clinton, Iowa, shops, to remove without injury the body front part from the body back part of Monitor injectors Nos. 7, 8, 9 and 10. When a Monitor injector needs overhauling, the injector has to be separated by taking off the nuts from four studs at *A* and separating the two parts of the injector at *B*, which is difficult to do unless proper tools are used.

Our method is as follows: The throttle valve is removed from the injector and the iron yoke *C* is placed over the opening and the plug *D* screwed in the throttle opening and a jam nut applied, which holds the yoke *C* in place as well as the two ¾x18-inch studs *E*. At the opposite end of the injector the brass stud *F* is applied, the yoke *C* is slipped over it and the jam nut applied, and by applying pressure to the nut *G*, the back body part will be separated from the front part without injury occurring thereby.



TOOL FOR SEPARATING BODY FRONT FROM BODY BACK ON STANDARD INJECTORS

*General foreman, C. & N. W. Ry., Clinton, Iowa.

Depreciation of Machine Tools

By W. W. Bird *

There is much confusion in regard to this problem due to unrelated and improper emphasis placed upon their point of view by the interested parties; the principal factors being first cost, years of service and salvage.

New tools should be put in whenever the productive capacity of the plant can be increased without an increase in expense, or when by replacing machines, the same productive capacity can be maintained at less expense.

*Director of the department of mechanical engineering, Worcester Polytechnic Institute.

The three principal factors upon which depreciation depends are: First cost, years of service and salvage. First cost minus salvage, divided by years of service, is the average annual depreciation. The confusion at present with regard to the problem of depreciation is mainly due to the unrelated importance placed by the various parties interested upon their point of view. The accountant decides on the book allowance for depreciation in such a way as to show in prosperous years a profit sufficient to pay a good dividend and leave a fair surplus, while in a poor year he fixes the accounts so that they will not show a loss; a process which may call for a negative depreciation.

The treasurer or whoever handles the bank account generally settles the question of first cost, and his decision is usually based upon cash in hand. The poor man buys cheap shoes, not because cheap shoes are economical but because they require less capital. The poor man pays cash for his railroad ticket, the business man has a mileage, while the capitalist travels on a pass—three stages in the bank-account scale.

The amount of cash on hand should be but one factor in settling the question of how much should be invested in a new machine tool, and large corporations do not as a rule purchase their machinery on this basis. It is a question of how many new dollars will come back for every old dollar spent. In other words, efficiency or the greatest returns for the least outlay. The cash limitations of would be purchasers also play an important part in the question of salvage, a factor which will be considered later on.

The shop superintendent generally decides on the years of service of a machine tool and usually without knowing all of the facts in the case. This naturally results in a wide range of opinions. In one shop machine tools are never old, and in the opinion of its superintendent they can do more work with their one old planer than any two new ones. In another shop one of these old planers has just been replaced by a modern one, twice as much work is being turned out per day, and this superintendent wonders who will be foolish enough to buy his old planer from the dealers to whom he sold it. Both of these men may be right, as the conditions in the two shops may differ; but in settling when a machine tool should be replaced by a new one, more light is needed and other factors should be considered. Even the startling illumination shed upon the subject by the traveling salesman may be as misleading as the twilight that gathers with the rapidly disappearing bank balance, which has caused many a superintendent to hesitate about making demands for new equipment.

The amount received for old machines is generally settled by the second-hand dealer. Occasionally a machine tool is junked, but this seldom happens to standard tools. A visit to a foundry scrap heap will reveal old stoves, printing presses, cotton machinery, water pipe, pulleys and gears, but lathes are few and far between, unless a recent fire in some local machine shop has produced unusual conditions. The salvage value is generally something more than scrap value and is determined by style, condition and market demands.

No.	Operated by Motor No.
Name	Size
Make	
Installed	Estimated Life ------ years
Original Value $	Estimated Salvage $
Weight ----lbs.	
Remarks	

American Machinist

FIG. 1. FORM FOR MACHINE-TOOL RECORD

Perhaps the most satisfactory way to handle this problem of depreciation will be to either reduce the viewpoints of the several parties to a least common multiple and then add them up or else figure the components of the various forces and get the resultant. We will first analyze the problem from the second-hand dealer's point of view.

THE SECOND-HAND DEALER'S POINT OF VIEW

The second-hand dealer buys on chance and sells on reputation, and his judgment is doubtless the principal factor. He looks a machine over and decides what he thinks it is worth and puts in a bid. The higher the bid, the better are his chances for securing the machine; the lower the bid, the better are his chances for gain. As he is probably in business for gain, it naturally follows that he will generally bid low. On the other hand, when he sells the machine his price is generally reasonable, for unless the purchaser gets his money's worth, he (the purchaser) will have something to say, and the second-hand dealer's reputation will suffer. In other words, a second-hand dealer must deliver the goods if he is to remain in business. If you wish to secure a good second-hand machine, buy it of a company which has been in business for a number of years and whose reputation is good.

It is very important in dealing with the subject of the loss in value of a machine tool to bear in mind that a second-hand dealer must either pay you less than a machine is worth or sell it for more than it is worth, and also to remember that while his reputation depends on honest selling, his success depends upon good buying. Consequently, you are more apt to lose in selling second-hand machinery than in buying it, and therefore it is always best to get bids from two or more reliable parties before disposing of old machine tools. On the other hand, it must be remembered that it is not always an easy matter to find a customer for a second-hand machine who is willing to pay all that the machine may be worth, and hence the second-hand dealer is entitled to a fair margin for assuming the responsibility of finding such a customer.

VALUE OF A SECOND-HAND MACHINE TOOL

It is not possible to determine the exact value of a machine except for a given set of conditions, and as conditions change, the value changes. There is also a question as to what the term "value" means, and perhaps it would be well at this point to define the term as it is used in this article. The real value of a machine in dollars and cents is what a willing buyer will pay a willing seller. Each party can figure out what the machine is worth to him, and reducing the two amounts to a common basis of willingness on the part of each to trade, we have the real value when the two amounts are equal. This value, however, is only true for the given set of conditions. The cash value of a machine is a different matter because the seller may not be a willing party to the trade. The value for taxes is usually quite different from the value for insurance, and the expression "cost to replace a machine" is misleading. However, we are not dealing with these questions in this article.

Some authorities claim that a real value is placed on a machine when it is sold at auction, but this is not always so unless

there is open competition. An expert does not usually bid himself because his bid is taken as an indication of his judgment of the value of the machine, and there are always those who are willing to risk a few dollars in raising his bid. If, on the other hand, the expert examines a machine, decides what it is worth, he may secure a "farmer" to bid half that amount for him, and then not be obliged to raise the bid in order to secure the machine. With expert rival bids, prices may go remarkably high, especially in prosperous times and we have records of tools several years old, selling for more than the actual price of new ones of the same style and make. This is in reality a premium on delivery. The second-hand machine means immediate delivery, while a new machine may mean a wait of several months.

We have spoken of the examination of a machine tool by an expert, and the question is: How does he put a value on the machine? The following are some of the items which he considered: Kind and make of machine; present condition of the market; location relative to the nearest market; style or obsolescence; condition or deterioration as shown by evidences of wear and misuse; probable cost for repairs, taking into account whether or not the makers are still in business so that broken or worn parts can readily be secured; system of lubrication; size of bearings and wearing surfaces. Thus the expert fixes a price which he as a willing buyer is willing to pay, bearing in mind all of the time that he must find a customer to whom the machine when fixed up will be actually worth the new selling price which he intends to put upon it.

Worth of a Second-hand Machine Tool to the Buyer

The next question is: What is the machine worth to the new owner, and this calls for an analysis from the shop manager's point of view.

The shop value of a machine should be based on its productive capacity, and in order to compare this value with its money value, both must be reduced to a common unit of measurement or a least common multiple. Money is defined as the measure of value and a medium of exchange, and for the present we can adopt no better unit than the gold dollar. The problem is how to get productive capacity into dollars and cents, as the selling price for a new machine or the bid from the second-hand dealer in case of an old machine, is already so expressed.

There are a great many elements which enter into this calculation, the most important one probably is the question of the nature of the work in the shop in which the machine is to be located. In a strictly manufacturing plant the problem is an entirely different proposition from that of a jobbing shop or a repair shop. This accounts for the fact that the same machine has such different values in different shops, since its productive capacity depends upon what it is to produce. Some of the other important factors are, the wages to be paid, the rental value of the space occupied, the cost of the power required, and the shop burden or overhead charge. These, and any other items which are to be considered, can all be reduced to dollars, so that we would have, by the expenditure of a certain number of dollars in the items considered, a definite number of dollars' worth of work produced with a given machine. If the machine is a new one, its money value is known, and we get a proportion between capacity and value. This proportion can be used to compute values of other similar but older machines in the same shop. The important thing to be remembered is that the values of two machines are to each other as their productive capacities only when all the conditions are the same or accounted for.

The interest on the money invested in the machine is a small matter compared with other items, especially labor, and it should not be allowed to figure too prominently in the solution of the problem.

If a shop has not modern equipment by which to determine capacity in terms of dollars, it will be necessary to estimate the same, basing the estimate on records of a similar shop or on the guarantees of the makers as to what new tools will do.

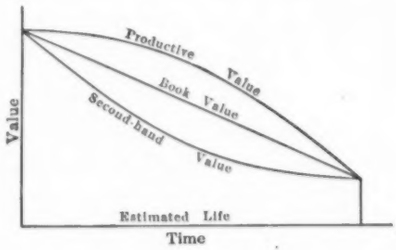
High-speed steel has made a great change in the productive capacity of machine tools, but it must be remembered that high-speed steels and other improvements also change the relation between capacity and value so that the actual value of a machine tool is not necessarily affected. An old planer may be as valuable today for certain work as a new one, for the simple reason that it fills the requirements for a given shop. On the other hand, an old planer in a manufacturing plant which will not permit of the use of high-speed steels is of little value in terms of capacity for that shop.

To answer the question of when to replace a machine tool, we would say: Put in new machine tools whenever the productive capacity of a plant can be increased without an increase in expense or when, by replacing machines, the same productive capacity can be maintained at less expense.

Necessity of the Individual Machine Tool Record

We will now consider the office problem from the engineer's point of view, and apply the results of our least common multiple. An individual record of each machine should be kept. Fig. 1 is a suggestion for a convenient form, and is the one which is in use at the Washburn shops of the Worcester Polytechnic Institute.

A complete record of the cost of repairs for each machine should be kept, together with the number of hours it has been out of commission on account of these repairs.



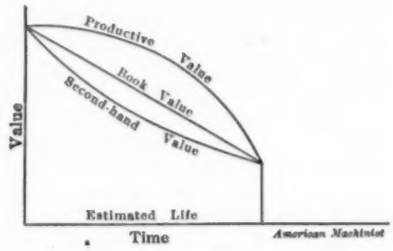


Fig. 2. Diagrams of Curves to Determine Yearly Machine-tool Depreciation

Fig. 3.

The question of whether the cost of repairs should be added to its value can be settled by noting whether or not the machine's capacity has been changed. Repairs due to accidents and natural wear differ from repairs which are in the nature of improvements, and since the value of a machine depends upon its productive capacity, the cost of any changes which result in increasing the relative capacity of the machine, should be carefully noted. If these data are at hand when the value of a machine is being considered, there will not be much difficulty in arriving at a correct valuation, or in deciding to accept a second-hand dealer's bid.

Probable Life and Loss in Value of Machine Tools

There is no way of judging of the future but by the past, and accordingly in estimating the probable life of a machine we must go more or less by previous records. From such data as we have been able to secure regarding standard machine tools from various manufacturing plants located in different parts of the country, we find that the number of years of service averages about 15 with a loss in value of 50 per cent. in lathes and planers, 60 per cent. in milling machines, and 75 per cent. in drills. This is simply an average, computed from records showing a very wide range. A number of reliable concerns report that a decrease of 10 per cent. each year in

value has always enabled them to finally dispose of tools without a book loss. This per cent. varies and is as low as 5 per cent. in some cases. A fair value for ordinary machine-shop conditions is 7½ per cent.

The life of a machine varies with the grade of work; class of help; piece work causes more rapid deterioration than day work; high-speed and heavy work also cause rapid wear unless the machines are especially designed for such conditions. The state of the art is an important factor in estimating the life of a machine. In the future the automobile will have a longer life when evolution has produced a standard type, as depreciation then will depend more on the wear and less on style.

Yearly Depreciation

Having decided on the estimated life and salvage of a machine, the amount to be allowed for depreciation each year, if it is to be uniformly distributed, can easily be determined.

The loss in value between first cost and salvage is the total depreciation and the difference between these two values divided by the number of years gives us the annual amount. In Fig. 2 the upper curve is the productive capacity value, decreasing more rapidly as time goes on. The lower curve is the second-hand value, decreasing rapidly at first and then less and less as time goes on. The straight line is the book value. If our estimates of the life of a machine and the salvage are correct, these two curves should cross at the time the machine is finally sold. If the class of work is such that the machine will turn out a product within given limits for a short time only, then its productive capacity value for that shop will drop off more rapidly and meet the second-hand value much sooner, as shown in Fig. 3.

A Few Suggestions

In conclusion, we would make the following suggestions: Keep the individual records as previously outlined; charge off 5 to 10 per cent. each year for depreciation, the exact amount to be fixed by the relation between the total valuation and the total depreciation of the machines as given by the estimate of life and salvage for each machine; when a machine is replaced, trade it in on a new one, securing two bids for the same trade if possible; start a maintenance fund in the next prosperous year and use that for the elastic end of accounting, increasing it in good years and in poor years decreasing it if necessary, by relieving the loss and gain account of the burden of depreciation; check up the total value of the machine-tool equipment account once in five years by a careful inventory based on productive value and the data on the cars of each machine, transferring any gain or loss to either the loss and gain or the maintenance fund account as the exigencies of the occasion may require.

In very large plants, the nature of the work varies to such a degree that one department can make good use of a machine which has been dropped below the requirements of another department. Thus machines may be passed down the line, regaining in part their lost value, as they go from one department to another until the scrap heap is finally reached. A good illustration of this method of passing things down the line is to be found in a large family of growing boys. Shoes are never outgrown. When they are too small for James, they will do for John, and if there is still any wear left when they cease to be of value to John they can be finally worn out by little Willie.

All progressive manufacturers make it a point to equip their plants with the very latest machine tools, and their unanimous testimony is that old machines should be replaced as soon as new ones of greater productive value can be secured. All express surprise at the amount they have received for the old machines which they have sold, after finding out how little these machines had really been worth to them in comparison with the new ones.

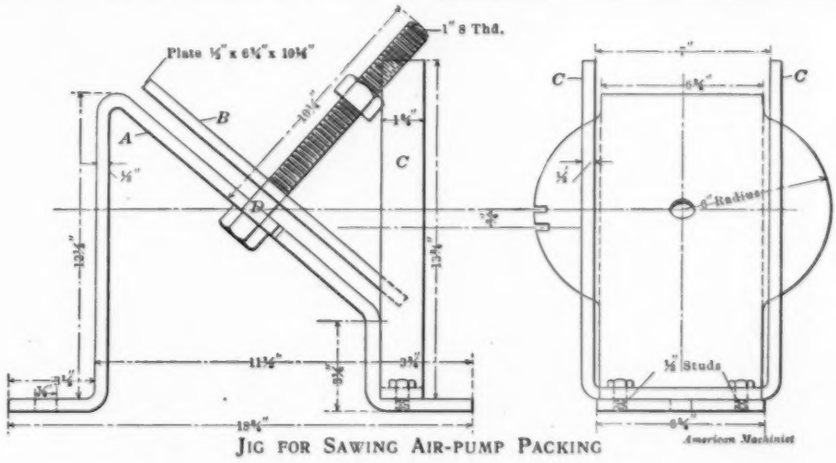
The best paying manufacturing plants today are those which have the greatest producing capacity for a given capital and the best engineering ability will be none to good to solve the problem of increasing capacity without increasing cost or capital.

Fixture for Sawing Packing Rings

Editorial Correspondence

A simple jig for sawing air pump packing that is both convenient and efficient, suggesting applications in other work.

One of the simplest fixtures we have seen for sawing packing rings is shown in the illustration. It was designed by Ferdinand Bauer, general foreman of the Beech Grove shops of the Big Four Railroad, for sawing the packing rings for air pumps, and consists of a main piece or body *A*, which is 6¼ inches wide at each end and is bent in the shape shown by the side view. The central portion under the washer plate is enlarged to a circular form, having a 6-inch radius, as can be seen from the front view. This is at the angle to give the desired cut to the rings.



Jig for Sawing Air-Pump Packing

The plate *B* is narrow enough to go between these uprights *C C*, which keep the rings to be cut in line vertically, as they simply bear against the edges of these uprights and are lined up automatically as they are placed over the center stud. After the stack of rings is in place, they are run up against a pair of milling saws which cut the piece in the casing by *D*, the work being set vertically past the milling saws until all the rings have been cut.

This is a very convenient device and might be made even more convenient for loading and unloading, so as to adapt it for automobile and other gas-engine work where it is necessary to handle a large number of rings in a very short time.

In a paper presented before the Iron and Steel Institute, it is stated that almost any degree of refining can be economically carried out in the electric furnace, and the removal of sulphur, phosphorus and oxygen is said to be extremely easy. It is therefore predicted that steel refined by electricity will largely replace ordinary crucible steel in comparatively few years.

A Set of Locomotive Scales

Editorial Correspondence

The increasing strictness of specifications by railroad companies regarding the weights carried by the different wheels of locomotives has led the American Locomotive Company to install at the Schenectady works the set of scales shown in the accompanying illustrations. The design of the outfit is due to the American Locomotive Company, and it is, we understand, the first of its kind.

A general view of the scales and scale house is shown in Fig. 1. Within the pit and resting on hydraulic cylinders, which in turn are supported by a series of masonry piers, is a track clearly shown in Fig. 1, on which run a series of independent scales. In use, the locomotive to be weighed is run within the scale house on the track at the edges of the pit, and the scales are then adjusted under it—one below each pair of wheels. At the top and outer ends of the scale platforms are a set of blocks which are placed under the wheels to which the scale is assigned, and are so located as to come immediately below the flanges of the wheels. The scales being properly adjusted the hydraulic (oil) pressure is turned into the cylinders when all of the scales rise sufficiently to lift the wheels from the rails, the weight being carried by the wheel flanges. It is then only necessary to take the readings of the scales in the ordinary way in order to determine the load on each pair of wheels.

Fig. 2 shows the supporting hydraulic cylinders and piers, this photograph having been taken before the house was built, and Fig. 3 shows a single scale taken from the opposite point of view to that of Figs. 1 and 2, in order to show the location of the scale beam and weights. In the left background of this view a three-throw pump appears, this being the means by which the pressure for lifting the locomotive from the rails was at first pro-

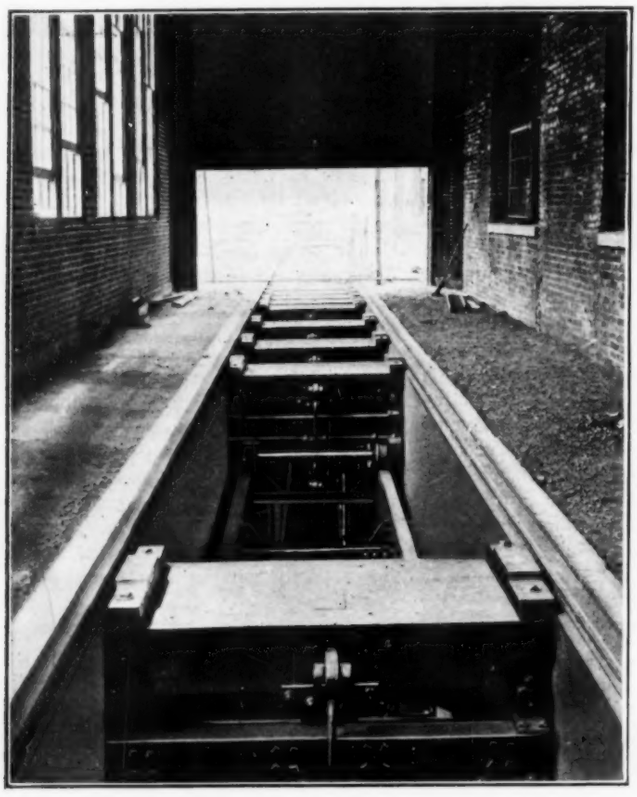


FIG. 1. A LOCOMOTIVE WEIGH HOUSE AND SCALES

FIG. 2. SCALE PIT, SHOWING THE LIFTING CYLINDERS

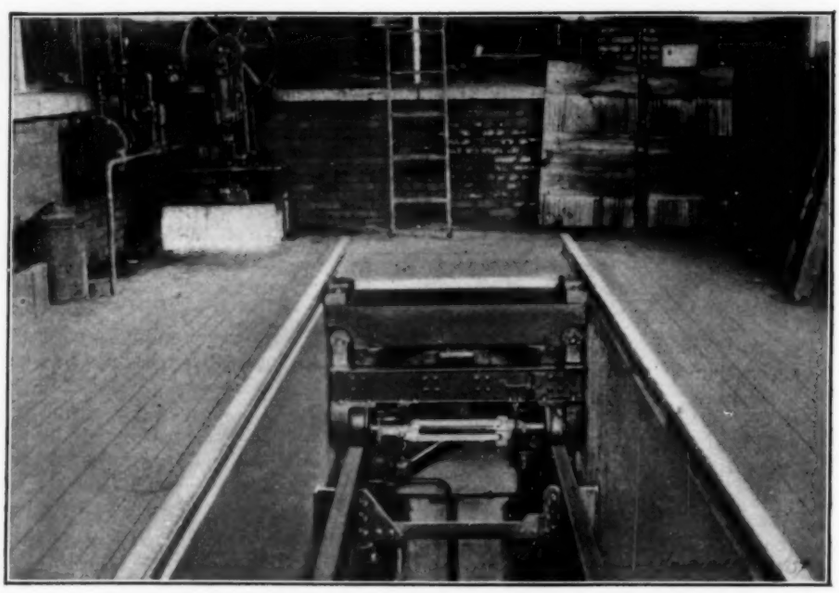


FIG. 3. A SINGLE SCALE FOR ONE PAIR OF WHEELS

duced. Experience, however, showed the pulsations due to a three-throw pump to be objectionable, and this pump has now been discarded for an intensifier, of which the operating power is compressed air, acting in a long vertical cylinder, above which is a smaller oil cylinder of the same length connected to the cylinders in the pit.

The number of scales included in the outfit is ten, which is sufficient for the modern Mallet articulated locomotive. The capacity of each scale is 35 short tons, while the total length of the house inclosing the apparatus is 71 feet.

Vertical Planetary Grinding Machine

The two grinding machines shown in the accompanying photographs are an interesting German development of the planetary spindle system, which is so well known to our readers as applied to horizontal machines. Fig. 1 presents an automatic universal cylinder, stud and slot-grinding machine with motor drive. Fig. 4 illustrates a duplex cylinder and stud-grinding machine. Both are built by Friedrich Schmaltz, G.m.b.H., Offenbach-am-Main, Germany.

The planetary construction comprises three spindles, one of which, carrying the grinding wheel, is placed eccentrically inside of the second, and the second eccentrically inside of the third. The wheel rotates rapidly about its own axis and slowly around the work, internally or externally. The diameter of this second motion is determined by the mutual angular setting of the two outer spindles, which may be altered while the machine is running. In a limiting case, the center of the solid working spindle falls on the center of the larger outside hollow one, and then the eccentricity is lost, the machine becoming a simple vertical-spindle grinder, adapted to straight-line work, or to radius and templet work if provided with suitable appliances.

Among the many advantages claimed for these machines, is the fact that the work does not have to be rotated, a paramount consideration in machining large pieces. The use of a horizontal table facilitates chucking and adjustment; holes and studs in the same piece can be ground without dismounting the work. The spindles have long bearings and are dust and oil tight. Precision is guaranteed to 0.0002 inch. The dust drops away by gravity.

Single-spindle Grinder

The grinder shown in Fig. 1 has, in its largest standard size, a main work table 16x80 inches. The planetary spindle has an eccentricity sufficient for studs 4 inches in diameter, which can be ground to a length of 73 inches. For internal grinding the capacity is 9 inches diameter by 16 inches deep. Straight surfaces may be ground to a length of 73 inches. The grinding spindle has a double belt drive, assuring the regular tension requisite for precision work. The revolving movement can be adjusted to 0.00004 inch, usually by hand, but if required by an automatic device. The vertical movement of the spindle, which is 22½ inches, maximum, may be executed either mechanically or by hand, and it may be accurately set for a certain travel, so as to grind studs close to the edge. The working table has coarse and fine horizontal adjustments and reversible automatic longitudinal stop

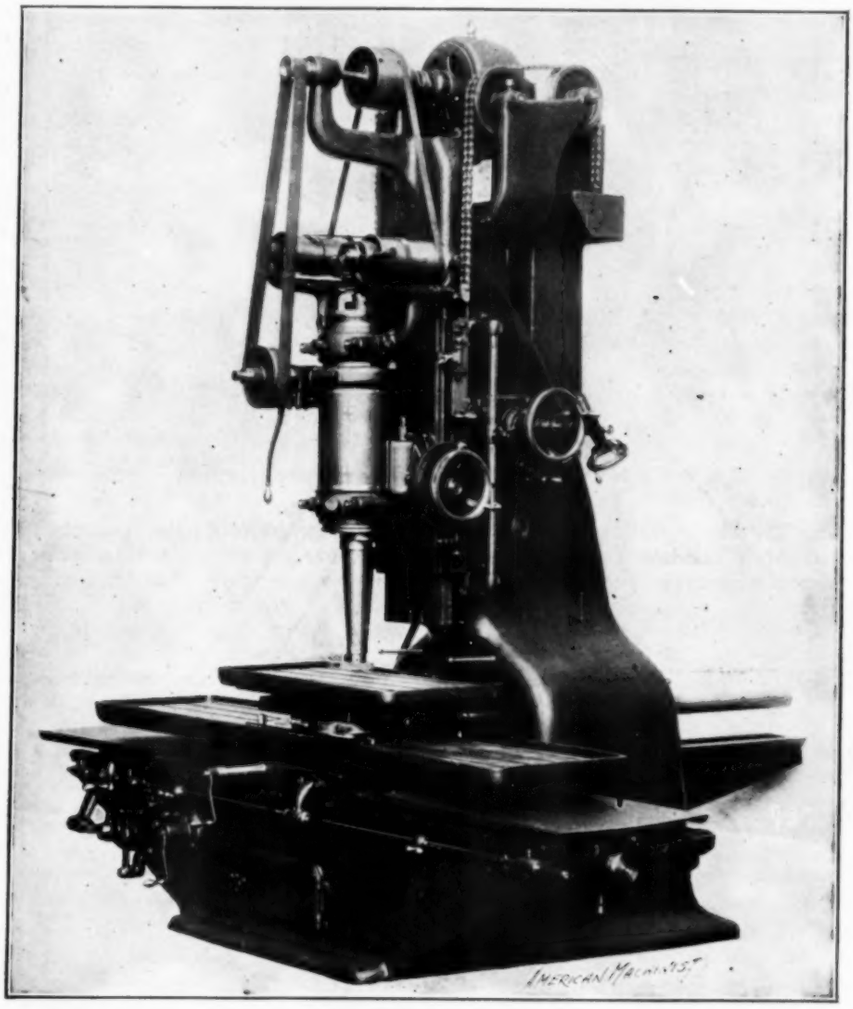


Fig. 1. Universal Automatic Cylinder, Stud and Slot-grinding Machine with Vertical Planetary Spindle and Electric Drive

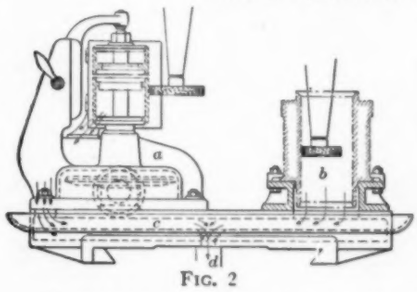


Fig. 2

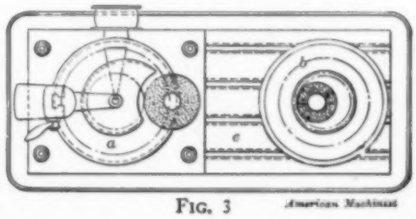


Fig. 3

Fixture for Precision Automatic External Grinding of Piston-valve Rings and Internal Grinding of Valve Chests

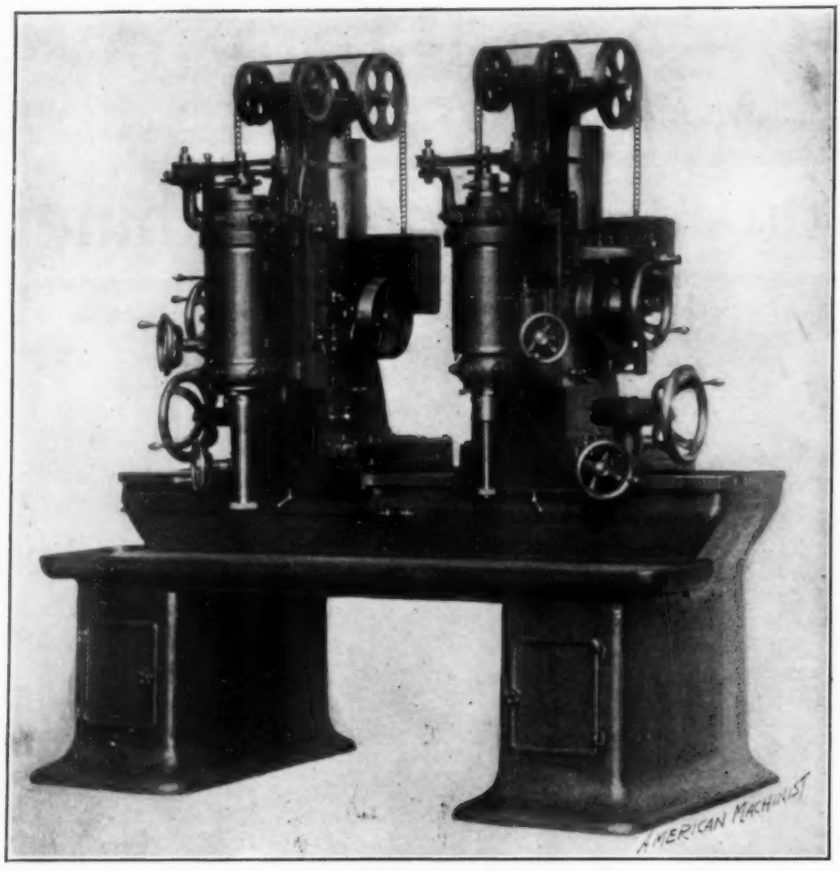


FIG. 4. DUPLEX CYLINDER AND STUD-GRINDING MACHINE

motion. The water-grinding arrangement consists of a cast-iron box with filter walls and centrifugal pump, and with water return.

This machine is shown with a radius attachment for grinding links, etc., which may have a radius from 20 to 70 inches, or greater, if specially provided for, and a slot length of 30 inches.

Another fixture, Figs. 2 and 3, is for precision automatic external grinding of piston-valve rings and internal grinding of valve chests for superheated-steam locomotives. The illustrations show how the valve chest *b* is mounted in the chuck that has been used for rough-turning it, and how the dust is removed at *d* by an exhauster; also the device at *a* for external grinding of the valve ring, which is mounted on an arbor between two dead centers and is driven by cone gearing running in oil bath *e*.

Further, there is an attachment for templet grinding of irregular curved surfaces, and one for circular surface grinding of piston rings, etc., by means of a round table with or without magnetic chuck.

The grinder is built also in three regular smaller sizes.

TIN SPINDLE GRINDER

The machine shown in Fig. 4 has a work table with chucking surface of 16x80 inches, and the grinding heads, which may be brought over any part of it, can be spaced from 22½ to 72 inches apart. The automatic vertical motion has a fine adjustment and a maximum travel of 12 inches. The revolving movement of the grinding spindle can be adjusted by hand while the machine is running, to 0.00004 of an inch. If internal work only is to be performed the grinder is equipped with spindles of eccentricity adjustable up to 0.8 inch radius; if external work, it is furnished with spindles having an eccentricity (presumably net) up to 2.4 inches radius. If desired, it can have one light and one heavy spindle.

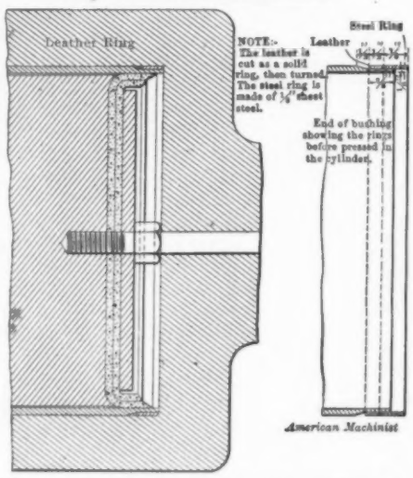
Making A Hydraulic Bushing Tight

By Chas. Markel*

Accompanying sketch shows the method that we employed to make a brass bushing tight in bottom end of cylinder of hydraulic crank-pin press.

The original construction of this cylinder was cast steel, and it was to be used by simply boring out to size, but when it was tried it leaked badly through blow holes in casting. To save the cylinder we had a brass bushing cast and pressed it into cylinder with good, faced joint at bottom, but when pressure was applied, it leaked between the end of bushing and cylinder, causing the bushing to be forced out.

We then cast another brass bushing with bottom in it, and pressed it into cylinder, but when pressure was applied, the oil worked through the bushing and leaked out between the bushing and cylinder. H. Harrison, one of the machinists in the shop, then suggested that we do as shown by sketch, which proved successful, and after two years' service it is absolutely tight at 200 tons pressure.


Leather Ring
NOTE:- The leather is cut as a solid ring, then turned. The steel ring is made of ¼" sheet steel.
Steel Ring
Leather
End of bushing showing the rings before pressed in the cylinder.
American Machinist

METHOD OF HOLDING BUSHING IN CRANK-PIN PRESS

The method employed was as follows: Bushing was turned down at back end, ⅞ inch long and then beveled ½ inch. A ring of harness leather was then cut ½ inch wide by ⅛ inch thick. A ⅞x⅛-inch hoop-iron band was then made and the ring of leather was placed over turned down end of bushing, and next to it the iron band.

When the bushing was pressed into cylinder, it first bottomed against the iron band, which in turn forced the leather ring against the bevel in bushing. This forced the leather solid against the wall of cylinder and bushing, making a joint that will hold 200 tons hydraulic pressure.

*Shop foreman, C. & N. W. Ry.

Sapphire Cutters and Other Tools

Editorial Correspondence

Some hand tools little known outside of watch factories and jewelers' shops, used in working various classes of material, including hard steel and rubber.

In a previous article we illustrated some of the operations carried on in the shop of John Worley, Waltham, Mass., in connection with the manufacture of jewels for watches and other mechanisms. Mr. Worley also makes a number of tools used by jewelers, watchmakers, and others, but little known to toolmakers and mechanics in general.

Some sapphire cutters of his manufacture are illustrated in Fig. 1. These tools are adapted for turning brass, gold, silver and nickel, and are also useful in cutting hard steel and turning hard rubber. There are, therefore, many places in which such tools should be of service in addition to the watch and jewelry shop.

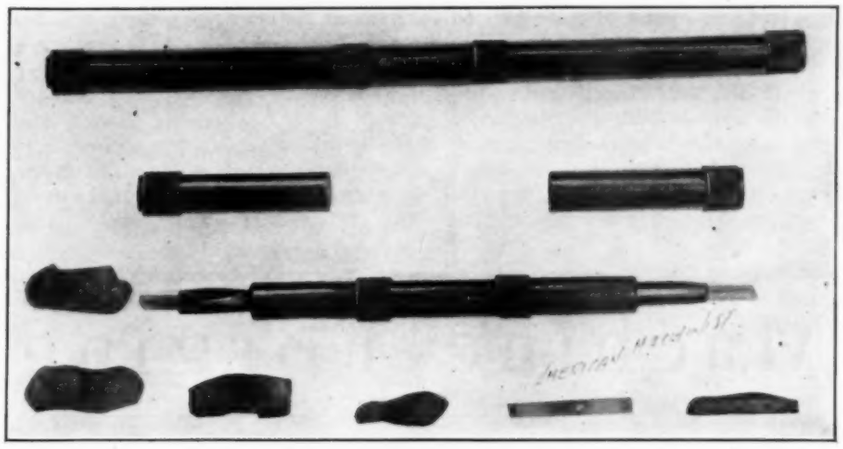


FIG. 1. SAPPHIRE HAND TOOLS

The tools consist of sapphire cutters, about ⅛ inch square, mounted in aluminum handles from which they project about ½ inch. The illustration shows one of these double-ended tools with the protecting caps at each end removed, and another tool closed at both ends. An interesting addition to this group is formed by the rough sapphire stone, partially cut piece and the finished sapphire section, which is ready for insertion in its holder. The method of cutting the sapphire to the required size is illustrated by Fig. 2.

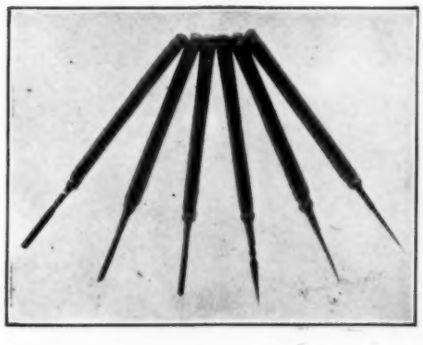


FIG. 3. A SET OF DIAMOND FILES

SAWING SAPPHIRE WITH A TIN DISK

The stones, which are Ceylon sapphires, are mounted for cutting upon a special rest, as illustrated in Fig. 2, and are held firmly in place by cementing to the swing rest. The cutting device is a thin disk of tin, about 3 inches in diameter, and with the edge nicked to form a series of teeth into which diamond dust is imbedded by a roll, which is held against the disk while the latter is rotated. With the edge well charged with the diamond the disk becomes a free-working cutter, which saws rapidly through the sapphire when the stone is pressed upward by the hand against the cutter.

The support for the work is adjusted endwise to a stop screw, which is set to give the correct thickness to the sapphire cutter sawn from the rough material. After one piece has been cut off the stop screw is adjusted, the rest slid forward, and another cut made. When the stones are in this way cut into small slabs, perhaps ½ to ¾ inch long, the flat pieces are again cemented in place upon the holder, this time resting upon one flat face, and are now cut to the required width. With the ends dressed at the proper angle the sapphire cutters

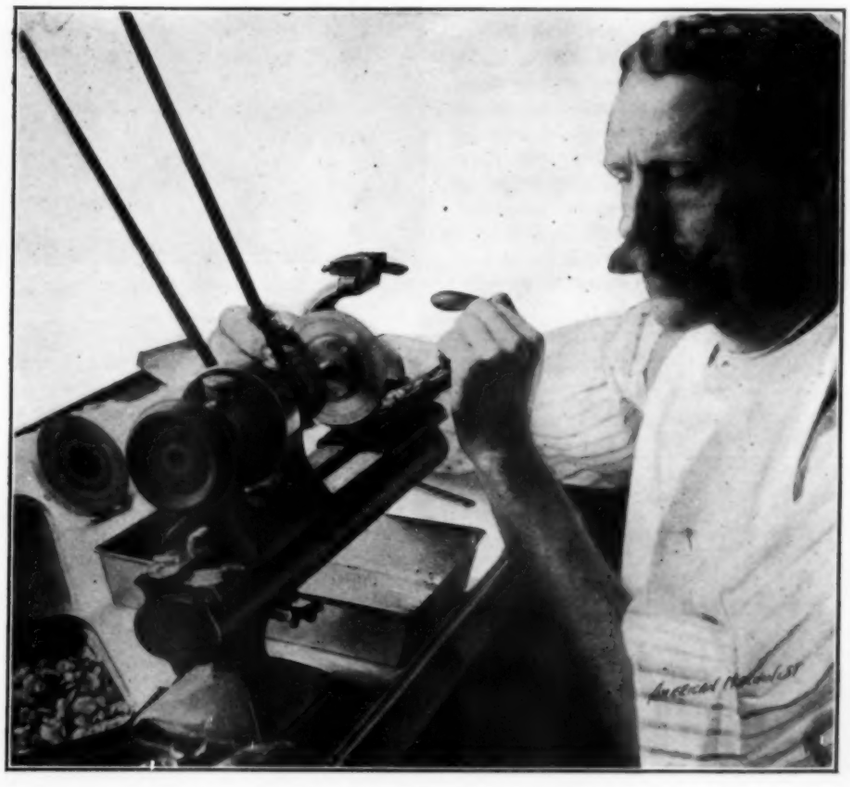


FIG. 2. SAWING SAPPHIRE CUTTERS WITH A DIAMOND-CHARGED DISK

are ready for setting in their holders.

During the process of cutting with the diamond-charged wheel, water is applied to the disk; in the case shown, a sponge is used which is dipped frequently in the water pan and then held against the tin while it is making its cut through the stone.

The rapidity with which the disk passes through the work is found rather surprising to the uninitiated. It takes but a few seconds to cut through a stone, approximating, say, ½ inch in diameter.

Diamond Files and Jewel Gage

Mr. Worley is an advocate of the lapping process wherever it can be applied, and Fig. 3 represents a complete set of diamond files or laps, which he manufactures for the use of jewelers, jewelers' toolmakers and others working on somewhat similar lines.

These tools have neatly shaped handles and in each is fixed a copper point, into which diamond powder has been pounded with a hammer. Some of the tools are round, some are square, some rectangular in section, and there are various other shapes in the set. These instruments enable the user to work down surfaces, enlarge holes of various contours, smooth gear teeth and do lots of other things to metals, either hard or soft. They can, in fact, be handled the same as one would use a file or a hand broach, and at the same time will cut materials where other tools would be useless.

Another interesting tool manufactured by Mr. Worley for gaging jewel holes is illustrated in Fig. 4. The jewels to be gaged are slipped over the long taper needle point and pressed back against the end of the instrument, the needle being carried back by the jewel against a delicate spring, and the pointer traveling with the needle indicating what size of hole is drilled through the jewel. The graduations on the scale read from 8 to 40, indicating, that is, from 8/100 to 40/100 millimeters, which cover the usual range of watch jewel-hole sizes.

Fig. 4. A Jewel Gage

Railroad Machine Forging

Railroad shops have probably developed machine forging to a greater extent than in any other line. Fig. 1 shows the size and the method of welding the sockets on the end of the grate shaking levers. The levers themselves are first forged in the regular way, the socket portion being prepared by rolling up a piece of machine bar which has been previously scarfed at the end in order to present a good welding joint.

The whole end is then heated to a welding heat, and on being squeezed in the dies shown, at the same time the forming plunger or mandrel *D* is forced into the opening, makes the completed lever as shown at *E*, which is all that could be desired.

Fig. 2 shows another example of this, being the dies and the driving spring bands which are produced with them. Those who are familiar with forging press or bulldozer work will readily see how these are produced.

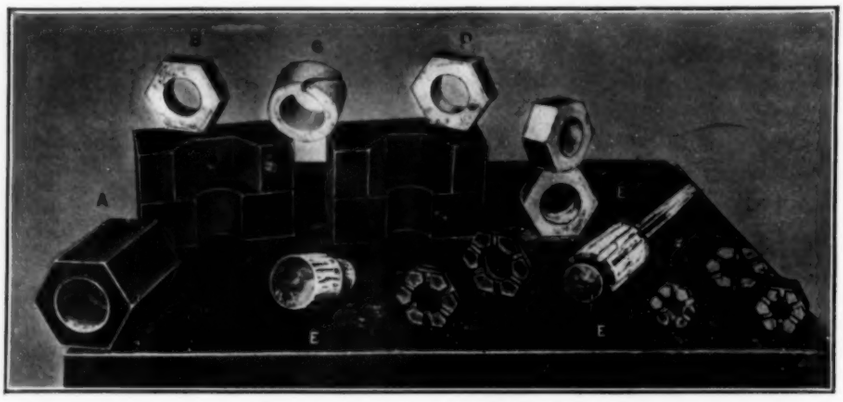


Fig. 3. Forging Castle Nuts

Making Castle Nuts

Castle nuts have become very common to locomotive practice, and Fig. 3

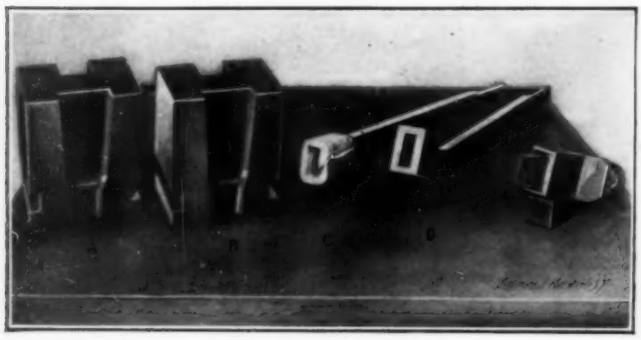


Fig. 1. Forging Grate-shaker Levers

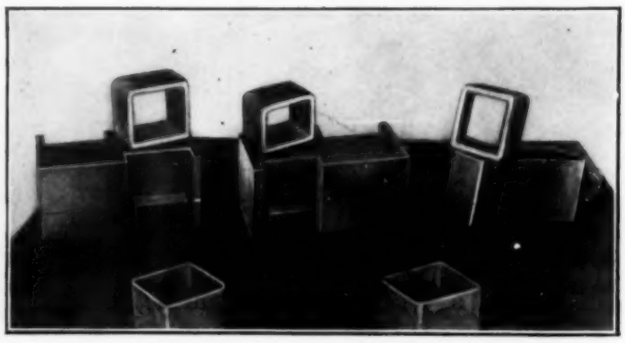


Fig. 2. Forging Spring-hanger Bands

shows how these are forged at the Depew shops. The blank for large-sized nuts are prepared as shown at *C* and are squeezed into hexagon shape in the dies shown by the plunger *A*. At the same time the small ends of pieces *E* and *F* are being forced into the center of the nut, and, while the forward projection is forming the hole, the inserted wings indicated are forming the slots at the six different points. This is largely cheaper in every way than milling these slots as is usually done on small nuts of this kind and has given entire satisfaction from all points of view.

Furnaces Using Gas and Water Only

Special Correspondence

A burner for furnaces that generates steam and superheats it under pressure, and then injects it into the gas. The suction thus created entrains the necessary amount of air. The products of this combination burn vigorously enough to produce the heat required to make furnaces hot enough for raising steel to the proper temperatures for hardening.

The kinds of furnaces, forges, blow-pipes, soldering irons, brazing tables, etc., that this burner has been applied to.

A new principle has been adopted for giving the proper blast to furnaces using gas for fuel, or rather an old principle has been improved upon and applied to furnaces by the National Economic Gas Blast Company, of New York. The principle on which they operate is that of injecting superheated steam into the gas as it enters the furnace.

One of the most popular sizes and styles of furnace that they are making is shown in Fig. 1. This furnace has an oven that is 3½ inches high, 6 inches deep and 10 inches wide. In it a temperature of 2200 degrees Fahrenheit can be maintained when it is desirous of hardening high-speed steel. The gas consumption at ordinary hardening temperatures is about 65 cubic feet per hour.

Its principal use is for hardening tools or small steel pieces. It occupies a floor space that is only 10x14 inches, and is very easily controlled by the operator from the front, as all the valves are within easy reach. The furnace is very similar to any other gas- or oil-fired hardening furnace, with the exception of the burner; that is, it is composed of angle iron and sheet metal that is lined with firebrick containing passages for the fresh gases to enter and the burnt gases to leave the furnace.

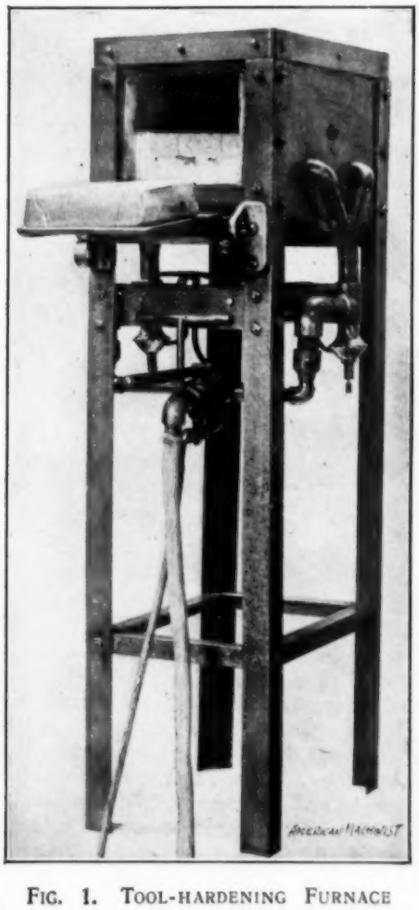


FIG. 1. TOOL-HARDENING FURNACE

THE BURNER

The burner that is used in this furnace, as well as all others made by this company, is shown on a larger scale in Fig. 2, where it is placed on an iron standard to be used as a blowpipe. The rubber pipe *A* connects the burner to the city gas supply, and the pipe *B* connects it to a one-, two-, or three-gallon water tank, as the case may be. This is hung from seven to eight feet above the burner, to give the water the proper head.

The water enters the burner at *C* and is converted into steam in the two side pipes *D D*. These two pipes have a row of small gas jets under each to convert the water into steam, the gas coming through the small holes placed in rows on each side of the pipe *F* as shown at *E*. The steam comes out of the pipe *D* at *G*, where it enters the central pipe *H* that is coiled at one end. It passes back and forth through this pipe to be superheated, after which it is injected into the gas supply at *I*. The gas in the meantime has been coming through the pipe *F*, where it picks up the necessary air supply at *J*.

OPERATING PRINCIPLE

The principle on which the action of this torch is based is that oxygen and hydrogen, when brought into connection with an open flame, will raise the temperature of that flame to a very high degree. Therefore water, which consists of two parts of hydrogen to one of oxygen, is converted into steam and superheated to make it thoroughly dry. It then becomes a combustible vapor when fed to the flame. Air also, which is composed of four parts of nitrogen to one of oxygen, when forced into a flame, will cause the flame to burn with a raised temperature. To force the air into the flame some mechanical apparatus has hitherto been employed, such as a compressor, bellows, etc., but this burner uses a different method.

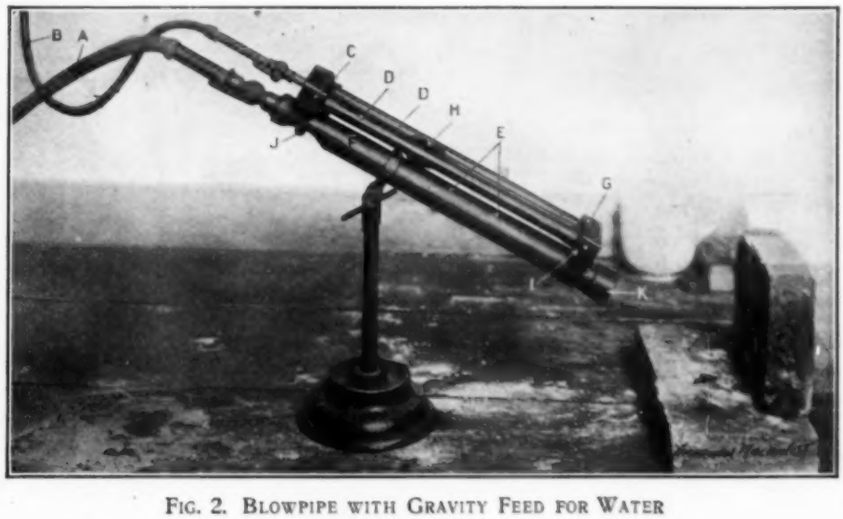


FIG. 2. BLOWPIPE WITH GRAVITY FEED FOR WATER

To briefly state the principle on which it works, a Bunsen burner is taken and two tubes, in which to generate steam, are attached to run parallel with it. A smaller tube is coiled up between these, in which to superheat the steam and thus convert it into a combustible vapor under pressure and inject in into the gas supply. The suction, caused by the steam being forced out of the nozzle of the injector under high pressure, causes the gas to entrain the necessary amount of air. The air, gas and steam are, therefore, closely mixed and converted into a gaseous fuel containing hydrogen and oxygen. These when ignited issue from the burner nozzle in a blast that is capable of melting copper, silver, etc.

Blowpipes

The burner as it is mounted on top of a small tank, that holds water, which is forced into the burner under pressure, is shown in Fig. 3 as it is being used as a blow pipe. To operate this, air is pumped into the water tank by the pump *M* and this forces the water into the burner through the tube *N*. The gas is then turned on through the tube *O*, which is connected to a city gas pipe, and it is lighted at the small burners *L*.

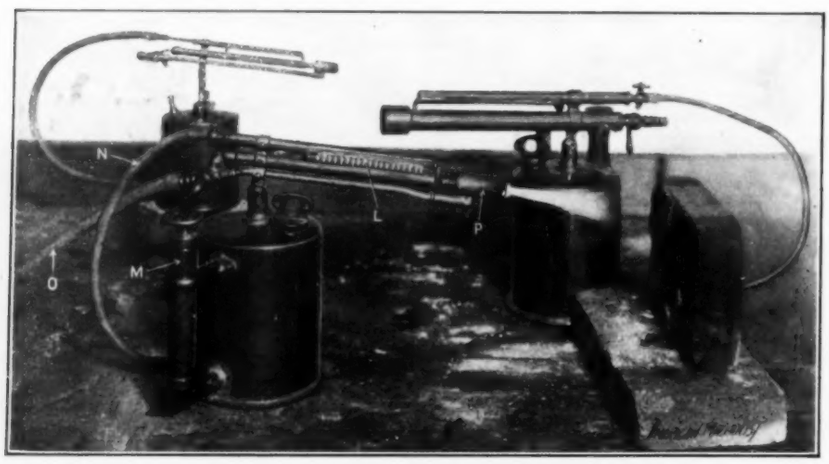


Fig. 3. Blowpipes with Forced Feed for Water.

These burners heat the pipes where the water is turned into steam and superheated. When this has been done the gas is turned into the pipe that conducts it to the end of the burner at *P*, where it is lighted to obtain the necessary blast for brazing, soldering, etc. Two other sizes of blowpipes are shown back of the one in use, and these can be used anywhere there is a gas jet for obtaining the necessary gas supply.

Bench Furnaces

In Figs. 4 and 5 are shown different styles of bench furnaces that are operated with this burner. The one to the left of Fig. 4 is a crucible melting furnace that consumes about 30 cubic feet of gas per hour. It will hold a crucible four inches in diameter and five inches high.

The one in the center is an open-front forge with down draft, while the one to the right is an open-end up-draft muffled furnace. Both of these can be used for heating small work for different purposes, such as forging, hardening, tempering, etc.

To the left of Fig. 5 is a furnace that was designed for dentists' enameling work, while in the center is a small crucible furnace.

At the right is a bench forge that is open on the top and has small square openings on the two sides to pass work through. The heating chamber is five inches long, two inches wide and three inches deep.

These merely suggest some of the various styles and shapes that can be made for burning gas fuel with this burner, and it is estimated that much less gas is used with it than with the ordinary air blast burner.

A brazing table is also made with two of these burners attached to it for generating the necessary heat. Several styles of soldering irons are made with it, as well as other apparatus.

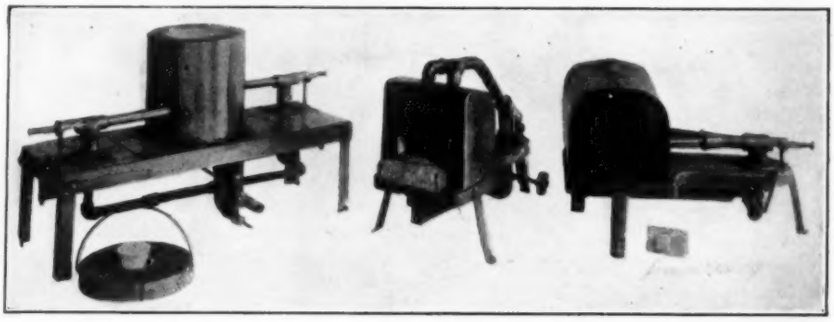


Fig. 4. Different Styles of Bench Furnaces

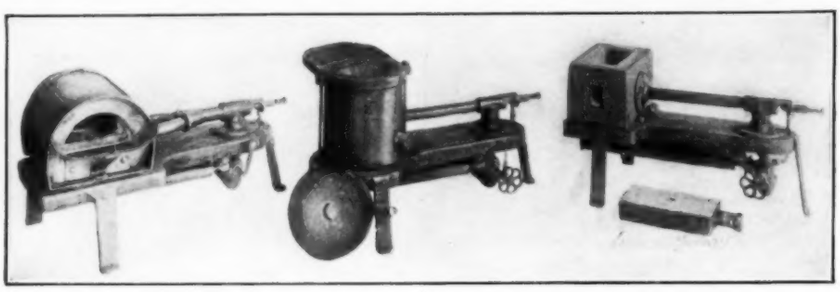


Fig. 5. Different Styles of Bench Furnaces

Soldering Rules

By W. E. Kline

Aluminum: Prepare aluminum by cleaning the surface to be soldered. Apply sulphuric acid, then coat with tallow. Use a freshly tinned soldering iron with sal ammoniac.

Cast Iron: When soldering cast iron parts, scratch brush the cast-iron part to be soldered with a brass scratch brush. Then apply regular soldering acid, covering the surface with a thin coat of tallow by heating the cast iron just enough to melt the tallow. It is now ready to be soldered by using ordinary soldering iron with sal ammoniac bath.

Cast Iron and Aluminum: Treat each part the same as described above, then press the parts together as desired, and heat enough to melt the solder. When finished dip in water.

Brass: For soldering brass apply regular acid and solder, having surface to be soldered clean and dry.

Brass and Aluminum: Treat the aluminum the same as described before. Treat the brass the same as described for brass. Then press together as desired, and heat enough to melt the solder. Have surfaces to be soldered clean and dry.

Always have soldering iron clean by using sal ammoniac.

Tests of Aeroplane Propellers*

By R. E. Dudley and Arthur Steed

Laboratory tests made upon air propellers of various pitches at various speeds to determine the relations of thrust to speed and horsepower required to drive, as well as the most suitable speed for different pitches.

Numerous curves plotted from test results show that efficiency decreases as the speed increases and that small pitch propellers are slightly more efficient than those of greater pitch. There is also a speed at which each pitch gives a maximum thrust.

*A thesis for the degree of Bachelor of Science in Mechanical Engineering from the University of Missouri.

Since the advent of air navigation in late years, aëroplanes and all that pertain to them are of general interest. The questions of construction and means of propulsion occupy first places in the minds of engineers. On the subject of propulsion for airships, very little is known to the public or engineering fraternity at large. Though numerous tests have been made upon propellers by the manufacturers and the operators of aëroplanes, very few of the results have been given to the public.

Most of the propellers used on modern aëroplanes are of the two-bladed, screw type, differing principally as to pitch, diameter and speed at which they are driven. Theoretically, the propellers should be of large diameter and slow speed to give the best efficiency, but in the case of aëroplanes the diameter must conform to the general design.

According to Dr. C. M. Woodward, of Washington University, the characteristics of the ideal propeller are as follows:

1. The radius must be as large as practicable.
2. The blade surfaces must be parts of right helicoids (i.e., like the bearing surfaces of a square-threaded screw).
3. Every blade must run to central hub with full depth.
4. The pitch of the screw surface must be determined by the speed of rotation and the velocity of the air through the propeller.

In this work it has been attempted to find the speed to give maximum thrust for propellers of different pitch, also to get a comparison of the horsepower required.

Construction of Propellers

Propellers for aëroplanes have been made of various materials, that is; aluminum, pressed steel, laminated and twisted woods, and some even of cloth stretched over a framework. The most popular form of construction seems to be of laminations of wood securely glued together. Spruce, ash and hickory have been used to a large extent for this work, but spruce seems to be the most satisfactory because of its light weight and exceptional strength.

Though a great many propellers have been built in late years, their design and construction have been jealously guarded by the manufacturers. For this reason no useful details of their design and construction could be found so methods had to be devised for building and proportioning the propellers to be tested.

At first it was proposed to use propellers 9 feet in diameter, but a suitable motor of sufficient power to drive them at the high speeds for which tests were desired, was not obtainable. As the only motor available for these tests was a Waddell Entz 16 horsepower, it was decided to make the propellers 5 feet in diameter.

Since the modern practice seems to indicate the use of propellers varying from 2 to 10 pitch, it was decided to make five propellers of 2, 4, 6, 8 and 10 pitch, of the true screw type, and to make comparison tests of these. (Owing to lack of time it was impossible to finish the ten pitch propeller).

Having determined upon the diameter, it was arbitrarily decided to make the width at the hub 5 inches and the blade to taper to 12 inches wide in the horizontal projection at the tip. The material used in the construction of the test blades was select spruce stock, dressed on both sides to ¾ inch thick; the best quality of hard glue, and white shellac.

To determine the thickness at the various sections of the blades, it was assumed that the maximum thrust possible to obtain from any one of the propellers could not exceed 500 pounds. The area of the various blades was found and the thrust per square inch calculated. A strip one inch wide in each blade was assumed to be a cantilever beam uniformly loaded, and the stress at the various sections was then found, from which the thickness was calculated by the following formula:

$$\text{Section modulus, } S = \frac{bh^2}{6} = \frac{M}{f}.$$

b = Breadth (known);

h = Thickness;

$$M = \text{Bending moment} = \frac{wx^2}{2};$$

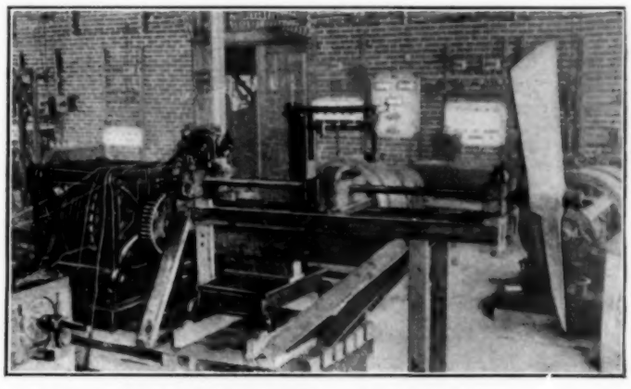


Fig. 1. General View of Apparatus

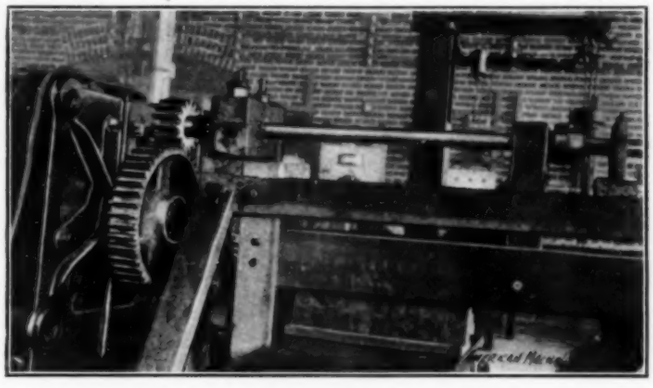


Fig. 2. Nearer View Showing Thrust Collar and Bell-crank Lever

Properly designed propellers of large diameter and slow speed always give the highest efficiency and as the diameter is decreased and the speed increased, the efficiency steadily drops. As seen from the results of experiments available, the thrust steadily decreases from about 50 pounds per horsepower, to 5 pounds per horsepower.

The item of efficiency is not of so much importance at this stage in the development of the aëroplane, as is the best speed and the best pitch. Hence the purpose of these experiments.

w = Pounds per inch length;
x = Distance to the section.
f = 2000 pounds per square inch. (Tensile strength of spruce per square inch = 16,000 pounds).

Solving for the thickness at various sections for the 2- and the 10-pitch blades, it was found that the 2 pitch required the greatest thickness of wood. Since the other propellers lie in between the 2 and the 10 pitch, it was decided to make all of them the same thickness as, or thicker than the 2 pitch. Thicknesses

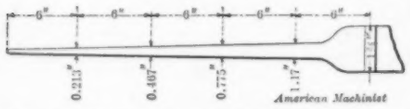


FIG. 3. THICKNESS OF PROPELLER BLADE

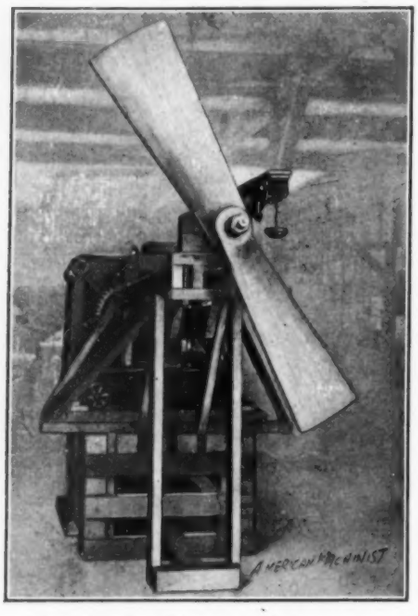


FIG. 4. END VIEW OF APPARATUS

calculated for the 2-pitch propeller at various sections are as shown in Fig. 3. Centrifugal force was neglected, the factor of safety of 8 being considered sufficient to take care of it. Each propeller was made up of a number of laminations securely glued together, the number of laminations depending upon the pitch. The angle at which the blade was cut was determined by the use of templets for each blade. The templets were made by developing screws 5 feet in diameter, of the required pitches. These templets were developed to one quarter size on the drawing board, and a full size section of the development 12 inches long was made for each pitch.

The proper number of boards were now glued together as shown in the illustrations, the ends of the boards being shifted over each other so as to give the proper angle and a 12-inch width at the end in the horizontal projection. The blades were cut from these laminated sections, the templets being used to get the correct angle. After getting the blades to the proper angle and thickness, they were accurately balanced and a 1⅝-inch hole drilled for the shaft. They were then sandpapered and given a couple of coats of shellac, after which they were rubbed and polished to give them a perfect surface.

APPARATUS

Apparatus for testing the propellers, included a crib work of 4x4-inch timbers carrying a motor, and serving as a foundation for framework supporting a driving shaft. This shaft was of 1⅝-inch cold-rolled steel, 8 ft. long, and was carried in two babbitted bearings, which were bolted to the frame work. A small bearing made of oak was placed near the middle of the frame to prevent vibration in the long shaft, which was driven by a Waddell Entz shunt motor, through a pair of cut spur gears having a ratio of 3 to 1. The larger gear was keyed to the motor shaft, and the small one to the propeller shaft. The motor was rated at 15 horsepower at 550 revolutions per minute.

For about 18 inches at the outer end, the shaft was threaded and the propellers were clamped between large nuts fitted to this thread. Large steel washers were placed between the nuts and the faces of the propeller so as to give a large surface and prevent crushing of the wood. Lock nuts were used to prevent any possibility of loosening.

Thrust in the direction of the axis, produced by a given horsepower was measured at a fixed point by causing the propeller to revolve without advancing or receding. Midway between the main bearings, a collar carrying a ball thrust-bearing was set-screwed to the shaft, the thrust being delivered to a platform scale resting on the cribbing, through a bell-crank lever pivoted to the frame. The arms of the bell-crank lever were each 14 inches long to the knife edges. Those on the vertical arm rested upon the thrust bearing, while those on the horizontal arm rested upon a steel plate on the scale platform. By having the arms of the bell crank equal, the thrust of the shaft was read directly on the scale. The scales had been overhauled

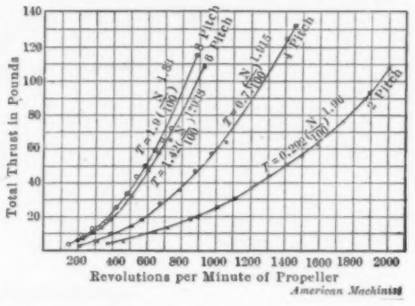


FIG. 6. RELATION OF TOTAL THRUST TO REVOLUTIONS

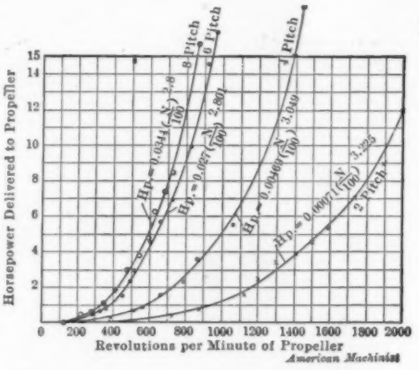


FIG. 7. RELATION OF HORSEPOWER TO REVOLUTIONS

and accurately balanced before being placed in position on the cribbing, and after the apparatus was set up ready for the tests, the zero reading was 10 pounds. The scales were the ordinary Fairbanks 1000-pound platform type, tested up to 500 pounds, and found to be correct within ¼ pound.

Speeds were measured with Schaeffer & Budenberg tachometers, also a speed counter and stop watch. The motor arm-

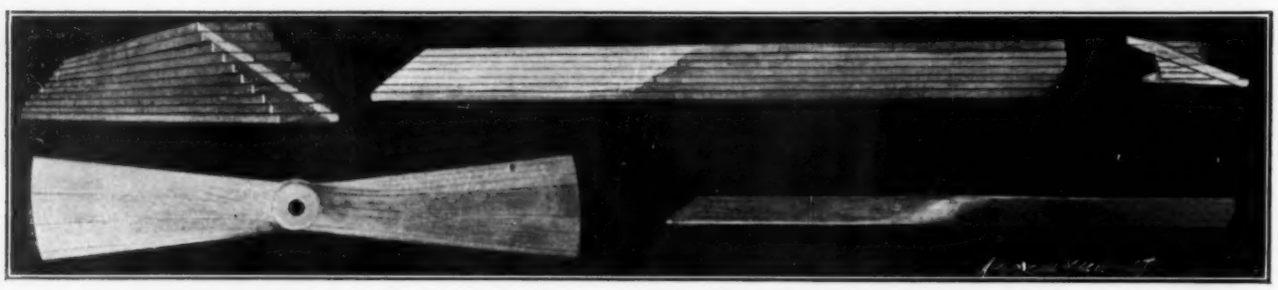


FIG. 5. THE PROCESS OF MAKING THE PROPELLERS

ature and field currents were measured with separate Weston ammeters, and terminal voltage of armature with a Weston voltmeter. All the above instruments were calibrated immediately after the test.

TEST

In preparing for a run, the doors and a couple of windows were opened in the laboratory where the apparatus was set up, as the suction and draft caused by the propellers was very heavy. After clamping the propeller to the shaft, the apparatus was allowed to run slowly for a while, so that the temperature of the various parts and the motor would become nearly constant. The propellers were then driven at the highest speed possible and the taking of data began. Starting with the highest point, the speed was decreased by corresponding steps and readings for the input of the motor, field current, revolutions per minute of motor, and thrust for each step were taken.

Each propeller was tested for the greatest range of speed obtainable with the motor used. For varying the speed of the smaller-pitch propellers, a number of variable resistances were used in series with the armature circuit for the slow speeds, and variation of the field excitation for the high speeds. In the larger pitches this same method was used for obtaining the lower speeds, but for the higher speeds the Ward-Leonard system of speed regulation was used. The field was separately excited throughout these tests.

All speeds above 150 revolutions per minute were taken with a calibrated tachometer, while those below this were taken with a speed counter and stop watch. One of the most noticeable things about the test was the small amount of vibration of the apparatus at high speeds.

Directly after the tests the motor was calibrated for the fixed losses at various speeds, for each value of field current; also all instruments used in the test. After calibrating the motor and instruments, all readings were corrected to their true value and the actual output of the motor found. From the recorded and computed data, various curves were plotted, which show at a glance the performance of the various propellers, also their performance with relation to each other.

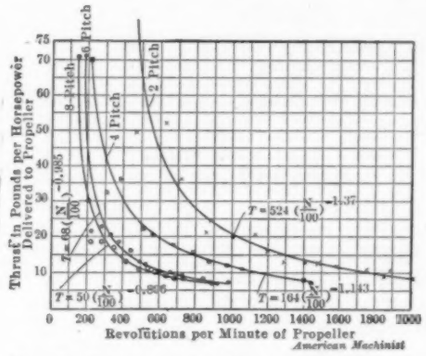


FIG. 8. RELATION OF THRUST PER HORSEPOWER TO REVOLUTIONS

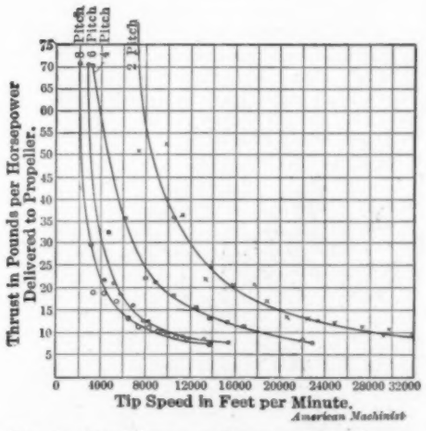


FIG. 9. RELATION OF THRUST PER HORSEPOWER TO TIP SPEED

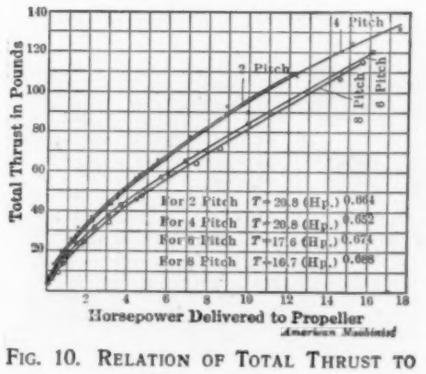


FIG. 10. RELATION OF TOTAL THRUST TO HORSEPOWER

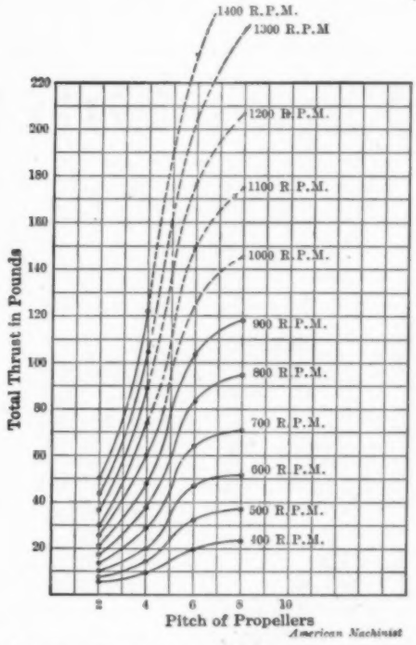


FIG. 11. RELATION OF TOTAL THRUST TO PITCH

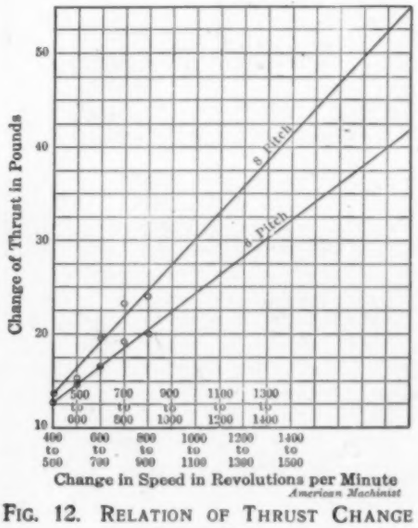


FIG. 12. RELATION OF THRUST CHANGE TO SPEED CHANGE

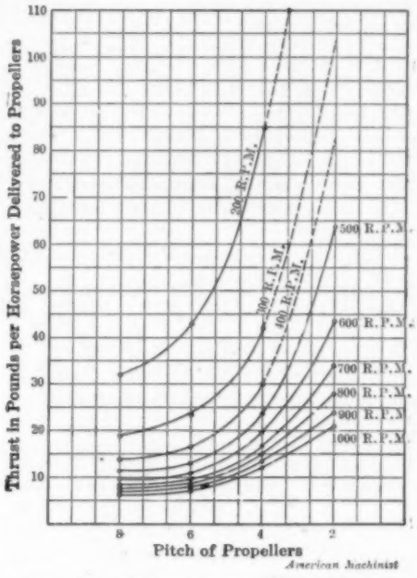


FIG. 13. RELATION OF THRUST PER HORSEPOWER TO PITCH

CONCLUSIONS

From curve sheet, Fig. 6, Total Thrust in Pounds Vs Revolutions per Minute of Propeller, we see that the thrust increases with the speed and follows approximately the general empirical equation:

$$Thrust = C\left(\frac{R.P.M.}{100}\right)^{1.911}$$

This was found by plotting these curves on logarithmic scale cross-section paper. The constant C may be obtained from the equation:

$$C = 0.28 \times Pitch - 0.315$$

which was found by plotting Pitch Vs. Constant of Equation, as taken from the formulas for curves in Fig. 6.

Curve sheet, Fig. 7; Horsepower Delivered to Propeller Vs. Revolutions per Minute of Propeller, shows that as the speed is increased the horsepower required to drive increases according to the parabolic equation:

$$M = ab^x.$$

These equations for the various pitches are shown on the curve sheet and were accurately determined for these propel-

lers by plotting the same curves on logarithmic scale cross-section paper. These equations came out in the form:

$$Horsepower = C\left(\frac{R.P.M.}{100}\right)^x,$$

the constant C and exponent x being determined for each pitch by the logarithmic curve method.

Curve sheets, Figs. 8 and 9; Thrust in Pounds per Horsepower Vs. Revolutions per Minute and versus Tip Speed in Feet per Minute, respectively; show that for propellers of the ordinary screw type, the higher the speed the lower the thrust per horsepower, or the lower the efficiency.

Curve sheet, Fig. 10; Total Thrust Vs. Horsepower Delivered to Propeller, is practically the same as an efficiency curve. It well shows that the efficiency is not greatly dependent upon the pitch, though the smaller pitches show a slightly greater efficiency than the larger.

Curve sheet, Fig. 11; Total Thrust Vs. Pitch of Propellers, shows that the thrust approaches a maximum as the speed is increased. It would seem from the study of these curves, that for the lower speeds it is not advisable to use greater than an 8 or 9-pitch propeller, as the curves show that the point of maximum thrust lies below the 10 pitch at these low speeds. For higher speeds the larger pitch may well be used.

Sufficient data was not available to obtain all points for the higher speeds so curves were plotted in Fig. 12; Change of Thrust, Vs. Change of Speed, the values for which were taken from the original full line curves in Fig. 11. From the new curves in Fig. 12 were obtained the approximate points and curves shown by the cross marks and dotted lines, on diagram, Fig. 11. It is to be regretted that sufficient data could not be obtained to complete these curves, but it is believed that the approximations are fairly accurate.

Curve sheet, Fig. 13; Thrust in Pounds per Horsepower Vs. Pitch of Propellers, shows the efficiency of the blades at different speeds, and also gives a comparison of the efficiency of the different pitches. It is evident, as is shown by Fig. 10, that the smaller pitches are more efficient than the larger.

In summing up the results of these tests, it is readily seen that the efficiency of propellers of this type decreases as the speed increases, and that the propellers are most efficient at slow speeds. It is also evident that while there is not a large difference, the small pitch propellers are more efficient than the greater pitches. It is likewise evident that there is a speed at which each pitch gives a maximum thrust.

Machining Taper Gib Crossheads

By H. H. Esbenshade *

Lathe and milling machine jigs, fixtures and tools and babbitting fixture used by a large engine builder to insure interchangeability and reduce the cost of taper gib crossheads.

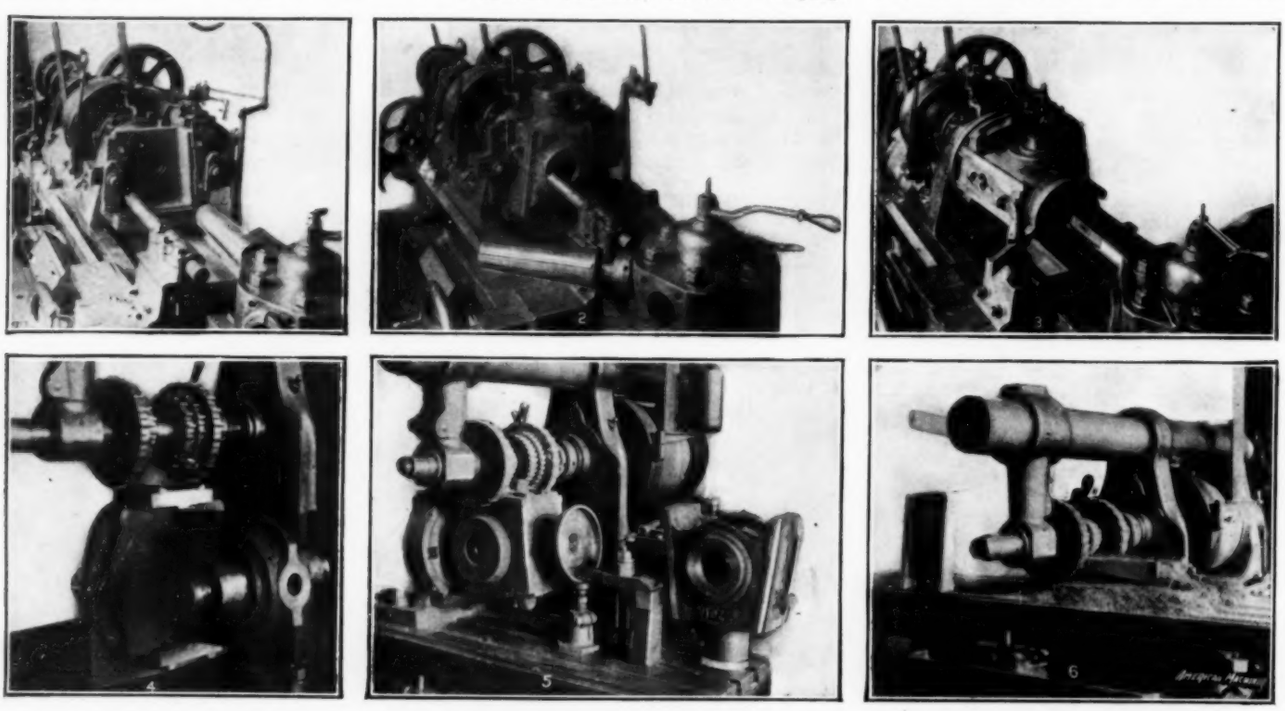
*Foreman toolmaker, the Frick Company.

The illustrations show the jigs and tools used in the Frick Company's shops at Waynesboro, Penn., for machining crossheads. Fig. 1 shows the jig for the first operation which is used in the lathe for holding the rough castings while the pin hole is bored and reamed and the inside is faced for the rod box.

Fig. 2 shows the jig with crosshead in place, with the clamps swung around in to place and gripping it. The wedges at each side compensate for any irregularity in the castings. Fig. 3 shows the second operation. The jig used for this operation is the same as shown on the milling machine in Fig. 4. The crosshead is slipped over the jig, the pin dropped into position and a tap on the pin tightens everything up solid. It is very necessary that everything should be rigid in this operation as the tapping puts a great strain on the work and fixture.

In this operation the crosshead is bored and tapped for the piston rod.

Fig. 5 shows the milling operation for the gibs. The jig used is that shown in Fig. 4. The work is held in the same way as for tapping for the piston-rod



MACHINING TAPER-GIB CROSSHEADS

hole. The jig is rotated half a turn when one side is finished and the other side is milled. Gang cutters with inserted teeth of high-speed steel are used for this work.

Fig. 6 shows the shoes being milled in a simple jig. Fig. 7 shows a babbitting jig for the shoes. With this jig the oil holes and oil ways are cast in place and no subsequent machining is required.

As shown the jig is apart with the shoe lying down, showing the oil ways. The two hooks on the part to the right hook over pins on the part to the left when the shoe is in place in the jig.

These few jigs and fixtures have reduced the machining time on crossheads to less than one-fourth of the time of the old way. In the milling of the crosshead the time was reduced over planing from 4 hours to one-half an hour.

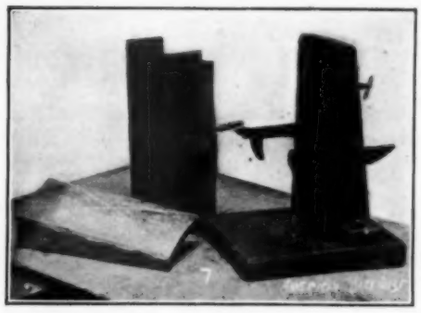


FIG. 7. THE BABBITTING JIG

Milling the gib reduced the time over planing from 3 hours to 45 minutes.

Die casting the babbitt on the shoe reduces the time over the old way of fitting to crosshead and turning in the lathe from three hours per pair to 15 minutes per pair.

In the two first operations, Figs. 1 and 3, the reduction in time is not so great as in the other operations. The greatest saving is in the chucking and clamping of the pieces. It must be borne in mind that the methods formerly used did not require the jigs necessitated by the latter.

Generating Cams and Ratchet Wheels

Editorial Correspondence

A few unusual cases of using a Fellows Gear Shaper to generate work usually done by the milling process.

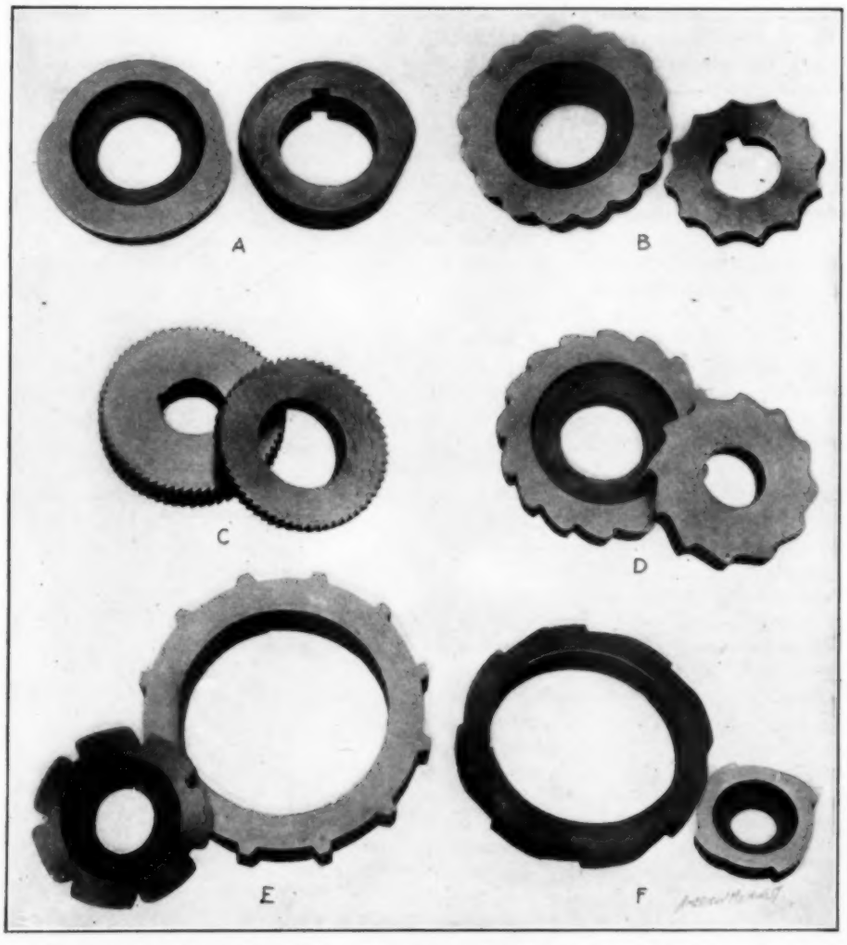
We have become fairly familiar with the generation of gear teeth for both spur and bevel gears, but we are not apt to think of other shapes being machined in the same way.

Among the interesting samples of work found in the Fellows Gear Shaper Company's shop, in Springfield, Vt., we have selected those shown, to give an idea of the variety of shapes which can be handled this way.

At *A* is shown a cam at the right, and the cutter which made it at the left. The cutter and work spindles are geared even and the cam generated as it is revolved. *B* is practically a form of gear tooth and is generated just as though it were a gear of 12 teeth. The same is true of the ratchet wheels in *C*, and the somewhat different form in *D*.

A form of sprocket wheel is shown in *E*, in which the cutter is smaller than the work and this is also true in *F*, where a 4-tooth cutter generates the 8-tooth ratchet with peculiar shaped teeth.

The cutters for such work are made by first making a cutter the exact size and shape of the work to be cut and using this to generate a piece which afterward becomes the cutter for the work itself.



EXAMPLES OF GENERATED CAMS AND OTHER WORK WITH THE CUTTERS USED

Too Many Men On the Job

It is not advantageous to have insufficient help, especially on repair work, but it is worse to have too many men. When they get in each other's way, and one has to wait for another, there is no economy in having so many men on the job and the quicker some of the force is sent to other work, the better for the cost sheet pertaining to that piece of work.

Take, for instance, the erection of a simple machine which must be located upon timbering overhead, and then hoisted into position. A recent case of this kind showed six of the ten men used upon the work could better have been laid off, and that the work could have been erected cheaper and better with four, than with ten men. All the lifting, pulling and hauling were done by brute force, hence the large force employed when two men with an adequate chain hoist would have easily handled the machine. While these men were actually at work, they worked hard—very hard and strained every muscle, but nine-tenths of the time they were standing idle, waiting for someone to do something, and evidently working on the plan of: "I keep still while you stir."

Letters from Practical Men

A Triple Feed Screw Machine Job

Fig. 1 shows an automatic screw-machine job which is exceptional for several reasons. The chief features of the layout are, that it requires a triple-stop lead cam and a triple form cam, that is, a lead cam which will bring the stop forward three times, and a form cam which brings the form tool forward three times. I use the term form cam in preference to back-slide cam, as the form tool may be used on either the front or back slide.

This piece was formerly made in two operations, the hole and one end being finished on the automatic screw machine, and the other end grooved on the hand screw machine. It was considered impossible to complete this piece on the automatic, and the purchase of a magazine attachment was being considered, when the present layout of cams was made.

In Fig. 1, the cut-off and form tool is shown by *E*. This tool cuts off the piece and forms the groove *A*. The other grooves, *B*, *C* and *D*, are made by the form tool *F*, by alternately feeding the stock and forming, as will be seen by the order of operations which follows.

ORDER OF OPERATIONS.

	519 Revolutions per Minute.	Hundredths of Cam Surface.
Cutoff and form groove *A*, 0.332-inch throw at 0.0017-inch feed	191 revolutions	44
Feed stock 1¼ inches	13 "	3
Revolve turret	13 "	3
Center, 0.125-inch throw at 0.005-inch feed	25 "	6
Revolve turret	13 "	3
Drill, 0.510-inch throw at 0.005-inch feed	102 "	24
Revolve turret	13 "	3
(Form groove *B*, 0.036-inch throw at 0.001-inch feed	36 "	9
Feed stock to stop	13 "	3
Form groove *C*, 0.036-inch throw at 0.002-inch feed	18 "	4
(Revolve turret)	13 "	3
Feed stock	13 "	3
Form groove *D*, 0.036-inch throw at 0.002-inch feed	18 "	4
(Revolve turret twice	26 "	6
Total number of revolutions for one piece	432 revolutions	100

Time for one piece, 50 seconds, or a gross product of 720 pieces in 10 hours. Maximum surface speed of stock, 69 feet per minute. Maximum surface speed while drilling, 23 feet per minute.

It will be noticed in the above layout, that the chip forming the groove *B* is lighter than for the other cut. This is because *B* is formed while centering, and if necessary could be made lighter still by continuing to form while drilling.

Fig. 3 represents a set of three cams,

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

each being shown by a different kind of line, and to aid further in distinguishing one from another, I usually make them with different colors of ink. To distinguish the three cams in the present illustration, I will state that the cut-off cam is from 0 to 44 in the circle, the form cam from 50 to 59, and again from 89 to 100. The lead cam, which operates the stops, center and drill, extends from 44 to 96.

There was difficulty in setting up this job, as the piece was six inches long, and the greatest distance between the end of the spindle and turret was only 5 3/16 inches, but we overcame this difficulty by feeding through the hole in the turret. Fig. 2 is the diagram of the turret. It will be seen that the center tool was opposite this hole, so it was necessary to put a threaded stop in the shank of the center tool.

A is the shank of the center tool, and B is the stop. *C* is the lock nut.

Cleveland, Ohio. S. H. BACON.

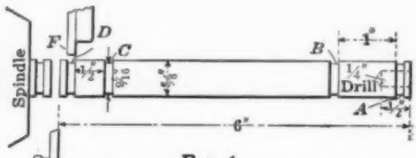


FIG. 1

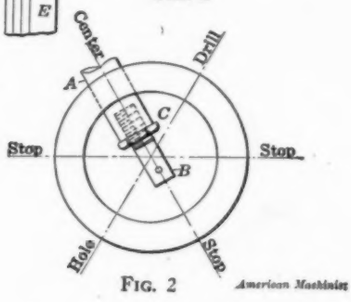


FIG. 2

THE WORK AND THE TURRET

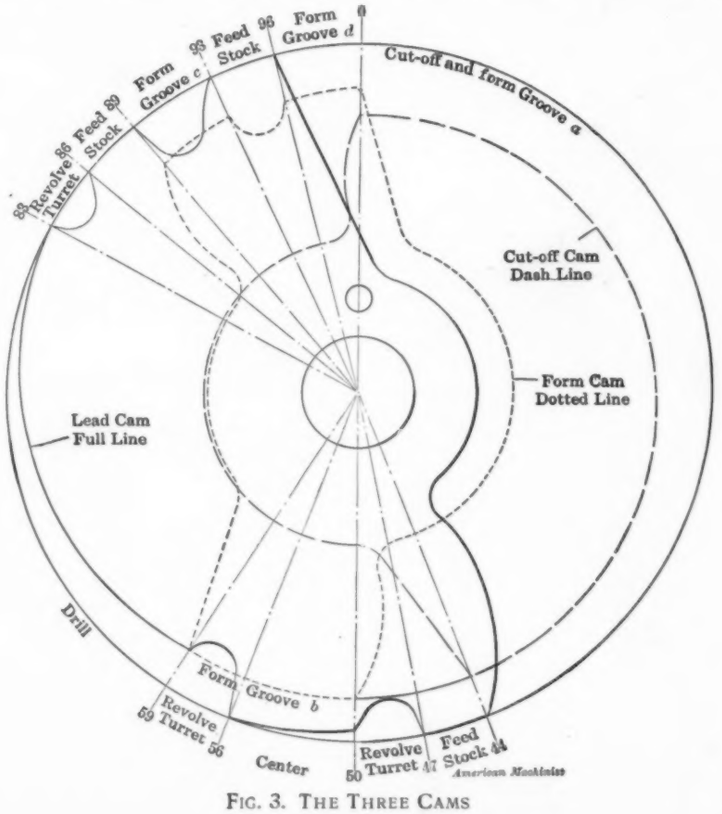


FIG. 3. THE THREE CAMS

Some More Effects of Carelessness

All of us are willing to admit that there is much carelessness which education has not yet elbowed off the earth, but I do not see how anyone could be so careless of his plain duty as not to try to supplement Entropy's article on that subject, which appears on page 383.

If I gather anything from this paper, it appears that learning, with the multiplicity of ideas which it confers, destroys the ability to remember. Entropy also seems to think that things half learned destroy the memory faster than if they are well learned. His remedies are, apparently, for us who are no longer young, to forget almost all of what we know already; to refuse to future generations all but the ability to dress, get to work, take orders, obey them, and get back to sleep; to employ only men who, besides being skilful, also have phenomenal memories; and also to employ all the cheap labor you can get, because, according to Entropy, cheap labor will unquestionably be dependable.

He also advocates employing certain men, a part of whose business it will be to make it generally hot for the careless one. We happen to know that this helps to prevent carelessness, but if we did not know to what extent and why, we could not learn from the paper under discussion.

In the whole article there is one statement which contains sufficient truth to merit consideration, but this statement being only half the truth, is worse than much that is entirely lacking in the precious element. This statement is that the "whole question is one of concentration on the business in hand." He also says that "responsibility can be placed by giving written orders." This, too, is true; but unfortunately the subject under discussion was the prevention of carelessness, not the placing of responsibility, and if there is any connection between these subjects, Entropy does not find it for us.

However, having stated Entropy's case, and given such credit as was possible, it remains to note the exceptions.

Some Exceptions

Before we go on with the main job of straightening, which, in truth, seems to be simple enough, let us notice a few little kinks which appear in addition to the general crookedness. For instance, we read that we should refuse to store away one single fact that we do not understand. It is a virtual impossibility to remember a collection of meaningless words, and however much a fact is a fact for the man who tells it to me, if I do not understand it, it is not for me a fact. It is only a collection of meaningless words, and I could not remember it if I would. On the other hand, it is very easy to understand a thing thoroughly and yet not remember it. As somebody puts it, you understand perfectly what your friend said to you a week before last, but you do not recall a single word of it.

The whole question is not one of concentration on the business in hand. Suppose you put a good, earnest man on a hurry-up job as, for instance, a crankshaft for President Taft's automobile, which has just come to your shop for repairs. Suppose you tell him to do a good, fast piece of work, but not to forget to blow the whistle at three-thirty. The machinist gets to work on the crankshaft, concentrates his attention on it, which is the business on hand, and, being right on the finish cut of one of the pins at three-thirty, he forgets to blow the whistle. Is this because he has not been concentrating on the business in hand, or because he did not understand the order? Evidently, neither. As a matter of fact, those who achieve most in lines requiring concentration and specialization are notoriously what is called absent minded. "Absence of mind" is really presence of mind. Tell a helper to blow the whistle at three-thiry and he will blow it then, not because he has a few ideas and can run over his whole list easily (no man's mind works this way), but being uneducated and without trained habits of thought, the idea "blow the whistle" stands out greater than any idea previously present, it is vivid, and if the helper is carrying bar iron past the clock and is also afraid of losing his job in consequence of not blowing the whistle, the idea will be more vivid still. If the person who gives him the order further instructs him to look at the clock every time he carries five bars of iron past the clock, *for the purpose of discovering whether it is three-thirty and time to blow the whistle*, the idea will continue to grow until it would be practically impossible to forget it. Put the helper to work on the crankshaft job and he will not come as near remembering the whistle as the machinist will. Cheap labor does not habitually remember if you give it thought-absorbing work to do.

Now, if the machinist is told to blow the whistle as soon as he has finished the crankshaft, so that the man who is waiting for it may know that it is finished, it is millions to one that the whistle will be blown at the proper time. Entropy says that your accountant, your most accurate man, will not blow the whistle on time. Under proper conditions, I believe that he will. If you tell him impressively to look at the clock every time he foots up a page and furthermore tell him to to make a note with his pencil on a slip of paper every time he looks at the clock, he, too, will blow the whistle on time. The reason is because you have connected the whistle-blowing with his regular, habitual line of thought and method of doing things, also, though somewhat artificially, you have connected the whistle-blowing with the business in hand, which is bookkeeping. But for certain obvious reasons, you might threaten to discharge the accountant if he forgets, and you might also give him a written order, and again, except for obvious reasons, you might have one of the men, whose duty it is to catch others napping, come in occasionally and raise Old Ned about the necessity of having the whistle blown at three-thirty. This would all help, for the remembering of a thing depends, (1) on its initial vividness, the written order, the impressive telling; (2) on its power to interest you, the fear of being discharged, the fear of being scolded by the napper-catching man, desire to please one's employer, etc.; (3) on its frequency or repetition, such as the constant seeing of the written order, making note of the passage of time after each page of accounting; (4) on its connection with your habitual line of thinking and working, in the case of the bookkeeper making notes with pencil after each page of accounting; (5) on attendant circumstances, like the presence of the clock and the written order.

Learn How the Human Mind Works

The way to get imperative, vital, but unusual and unhabitual things done is to learn how the human mind works and then leave no stone unturned to make use of it in its ordinary workings. Give your orders properly to the proper man, and they stand a better chance of being remembered. Teach yourself to remember by taking advantage of the knowledge of how memory works. A fact comes up in the mind in accordance with certain laws. Lay hold of these laws and use them. No man arrives at the fact he wants by running over his stock of ideas. Any knowledge is better than not to have it, as to know that the sun gives warmth is useful knowledge to an ordinary man, though this single fact about the heavenly bodies would be a poor stock-in-trade for an astronomer. It has been said that an engineer's value and greatness depend on the size of his scrap heap, by which is meant the number of old, used, and even spoiled ideas lying around in his cranium. Nothing is truer. The more ideas we have, the better and more valuable we are, to ourselves, and to others.

The reason that men acquire the power of getting hold of a needed fact on short notice is, not that they have systematized their facts, as in a card catalog, for such a thing is not conceivable in any real sense, but it is because they have systematized their methods of thinking, they have learned by a cut-and-dry method, and most often they are unconscious that they have a method, how to place themselves in a situation or train of thought which will cause them in the shortest time to arrive at the fact for

which they have need. Believing these things firmly, I close, almost, but not quite, with Entropy's last words: "What is needed is more education and more accurate knowledge of a few things about the memory."

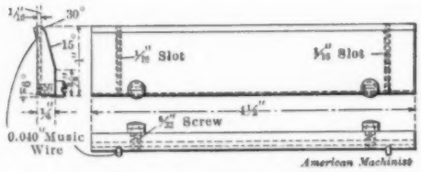
Pasadena, Cal. J. O. BARNWELL.

Toe Dog for the Shaper Vise

The cut herewith shows parallel toe dogs, which will adjust themselves to the work, the spring wire allowing the downward pressure to come entirely on the work.

The 5/32-inch screws make them much lighter and also make them take the proper position when the vise is closed against them, that is, the back face will lie flat against the vise jaws.

The spring wires are soldered in and



TOE DOG FOR THE SHAPER VISE

hold the thin edge about 1/32 inch high when in the vise.

All that is necessary is to place the work to be planed in the vise with one of these parallel toe dogs on each side and close the vise against them. If the strips are made in the proportion here shown, the work will be well bedded without further efforts.

Waterbury, Conn. C. P. MACARTHUR.

Marking on Steel or Iron

If you want to make a good, durable mark on smooth iron or steel without etching it or making any marks or scratches in it, get the bluestone you use when you copper plate it for scribbing lines in for laying off. Dip your pencil or scriber in the bluestone and make the marks you wish on the steel with it.

They will, of course, be copper colored marks; if you want black marks rub your lead pencil over them while they are wet. This marking will stand all ordinary usage but can easily be removed with emery cloth or scraper.

Baltimore, Md. F. E. FICK.

Truing Up India and Carborundum Stones

Carborundum and India oilstones soon become worn in spots, and may be cut down by the following simple method. Take a flat piece of cast iron and rough plane it on one side, or, if you can get a piece of large emery wheel that has been broken it would be better still. Next get some No. 40 or 60 emery and spread it on the plate or wheel and rub stone the same as in lapping.

When the stone commences to get sticky, clean off the plate, or wheel, and stone, and put on fresh emery. Repeat until the stone is perfectly flat, which takes only a very short time, clean the stone in benzine and it will be like new.

New Britain, Conn. C. BILLINGS.

Making Socket Wrenches Complete from the Bar on a Jones & Lamson Flat Turret Lathes

In the shops of F. L. Schmidt, Twenty-first street and Eleventh avenue, New York, we have, each year for the past five or six years, required about 1000 of the drop-forged socket wrenches shown at *A*, Fig. 1. These wrenches are 14 inches long and cost net $1.15 each. Two of these go with every machine we build, which makes the cost for wrenches for the machines pretty high.

The drop-forged wrench is not by any means a thing of beauty.

I devised the following method of mak-

FIG. 2. THE BROACHING TOOL

ing them complete from the bar on the Jones & Lamson flat turret lathe. The stock used is 7/8-inch cold rolled, the center part is reduced to 1/2 inch for about 12 inches. The hole in the end is first drilled with a twist drill held in the turret. The next operation is to recess the bottom of the hole for chip clearance in the squaring operation which follows. For this operation the spindle is stopped and the rectangular slotting tool, Fig. 2, mounted in the turret, is pushed into the center of the hole. The turret is then run back and the head fed a short distance across the bed and another cut taken, and so on till the head abuts against the front stop. The direction of feed on the head is then reversed and cuts taken till the head strikes the back stop and the square hole is completed. The stock is then fed out and the body is reduced for the required distance and the piece is cut off. This gives a first-class wrench complete in about 18 minutes, the squaring taking about two minutes.

New York. FRANK BENNER.

The Uplift of Higher Wages

Time was when an employer considered his duty done when he paid his help their wages and furnished them such accommodations in the way of tools and buildings as he could afford, or he thought most profitable to him. Before that there was a time when employers expected their help to live with them and share their food and when they expected to take care of their help if they were sick. This was when men really helped one another.

When a boy was 14 or 15 years old he was sent out to "help" some man get in his hay or blow the forge. The pay was a minor thing, the real consideration being a home and food and clothing even if there was a poverty in choice of neckties. The change came when employers preferred to pay for the employees' board rather than furnish it themselves. It marked a change in the financial state of the employer and was a sign of prosperity, for when he boarded his help it was his wife that earned the money that was thereby saved. It also marked the emancipation of women. The employer then found himself face to face with the problem of making as much profit as before without his wife's aid as boarding-house keeper. To do so he had to get all the work possible for a dollar and he had none for the amenities of life for others than his own family.

Today men, some men, are making more money than even their wives need. They think of the welfare of their employees (no longer "help," for they work only to help themselves). They build for them gymnasiums, baths, pretty cottage houses, conduct lecture courses and establish libraries. And then they wonder why their offerings are neglected.

The reason is not far to seek. A real live boy or man would rather walk 10 miles after chestnuts in the woods than

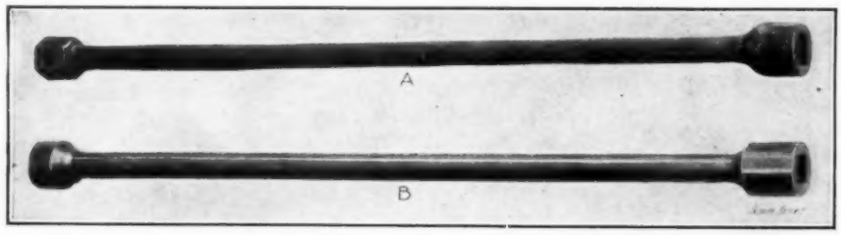


FIG. 1. THE SOCKET WRENCHES

spend 10 minutes in a steamy, stuffy gymnasium. He would rather dive in a pond away from civilization than stand in a shower bath. He would rather live in a house with five other families, where he can go out of an evening without his wife being scared about burglars, than in the dinkyest little cottage that ever was built off by its lonesome. He would rather listen to a street piano or see a 10-cent rough and tumble "show" than hear, Elbert Hubbard talk about what he cannot understand, and the daily paper is his literary limit.

The trouble is that, as the employer has made money and spent it, his ideals of life have risen and he expects his employee's ideals to rise with one bound where his have risen so slowly that it has been imperceptible from year to year. What the employee prefers is the same money distributed as wages, barring what little is needed for purely sanitary improvements made necessary by the crowding of many workers in close quarters. The money which comes into the hands of employees determines their real social status. If they have money enough assured to feel safe to get an instalment piano and an instalment house the question of social uplift is surely given a start in the right direction and the tendency toward the more artificial enjoyments, which are now so often offered and spurned, is established. Whether it is best for a people to have this tendency toward artificial pleasures is an open question, but it is the fashion of the times and evidently the thing that our social-improvement workers are aiming at.

Springfield, Mass. ENTROPY.

An Adjustable Ellipsograph

Ellipses are constantly having to be drawn in connection with the work of certain drawing offices. In some cases they must be fairly accurate, and in others an approximation to an ellipse is quite sufficient. If accuracy is desired, the help of an ellipsograph of some kind is most necessary. On the other hand, if a rough ellipse will suit the purpose, there are a number of ways in which it can be drawn without the aid of such an instrument, but the process is slow and far from satisfactory.

The illustrations show a handy instrument, which, if well made, will draw, within certain limits, ellipses of any width or length more quickly and more accurately than any of the methods generally employed. Its construction is founded upon the well known trammel method of drawing ellipses, and the instrument consists of five parts, a table, a trammel, two slides and a pencil holder.

Fig. 1 represents the complete instrument. The table is cut out of sheet brass about 3/32 inch thick, and is provided with two slots at right angles, each being about 3½ inches long by 3/16 inch wide. In each corner is riveted a turned steel leg 1½ inches long. These legs are tapered from the tops down to small shoulders and finally end in needle points, the shoulders being provided to prevent damage to the paper. In making these instruments it is important to see that the needle points lie in planes passing through the centers of the slots and truly perpendicular with the table. Carelessness in this particular results in ellipses which are not true with their axes.

The trammel, Fig. 2, is also cut from 3/32-inch sheet brass. It is provided with a hole for the pin, carrying the pressure-regulating stud, and a slot for the pencil holder. Fig. 3 shows the two slides and pencil holder in position on the trammel. The outer end of the latter is carried on a pin *J*, with shoulders at *A*. *C* is a small disk screwed to the top of the pin, and held up by means of a spring *D*. The trammel is carried between the shoulder *A* and the washer *K*.

Slide *F*, Fig. 3, also of steel, is seen in detail in Fig. 4. For accurate work its length should be 2½ times the width of the slot, and it should be made a nice, working fit. The adjustable slide *G*, Fig. 3, is made to the same dimensions and is carried on a pin *H*. Below the slide is shown a washer *Q*, and the trammel is held fast between this and the head of the pin. A bush *B*, into which the nut is tightened, is also necessary, in order that the pin may turn freely in the slide, as the latter moves up and down its slot. Sharp corners must be avoided in both slides, as they are liable to foul at the crossing of the slots, when small ellipses are being drawn.

The pencil and its holder are seen in Fig. 3, but if it is so desired, a pen can easily be fitted instead. The position of the pencil in the trammel can be adjusted by means of the nut *N*, and the point can be raised or lowered by pressing with the finger on the disk *C*.

All the parts are simple, and it is not a great task for a mechanic to make them, but it should be remembered that when the instrument is in use, there are two sliding and two turning parts in operation simultaneously, and consequently, if accurate results are desired, care should be exercised in the making.

The size of the instrument here shown will give ellipses from one to four inches in length, and the width can, of course, be varied within the same limits. In designing for larger sizes, the following method should be pursued. First; set out the trammel, as in Fig. 2, making the center distance *E F* equal to one-half the length of the greatest axis with which the instrument is required to deal. Next; draw the slides in position on the trammel, as in Fig. 3, and then proceed with the table. The length of the slots in the table should be equal to twice the distance *L M*, and the clearance between opposite legs equal to twice *O P*.

To use the instrument, draw center lines at right angles and mark off the axes. Set the instrument with the four needle points on these lines, thus center-

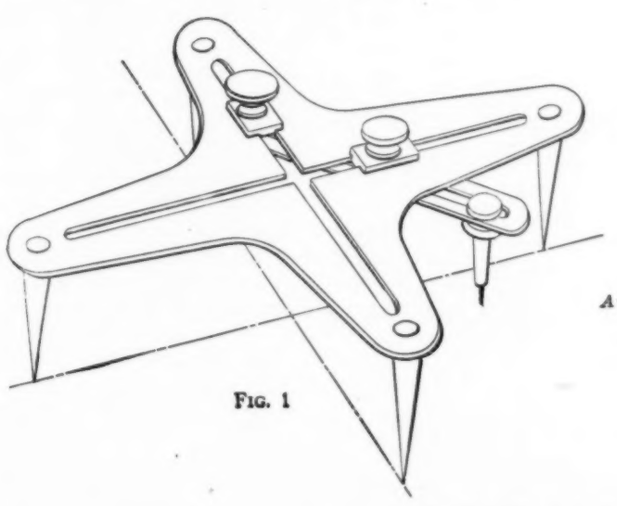


FIG. 1

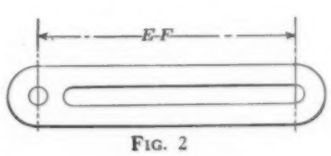


FIG. 2

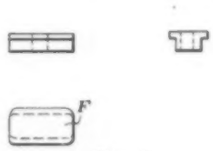


FIG. 4

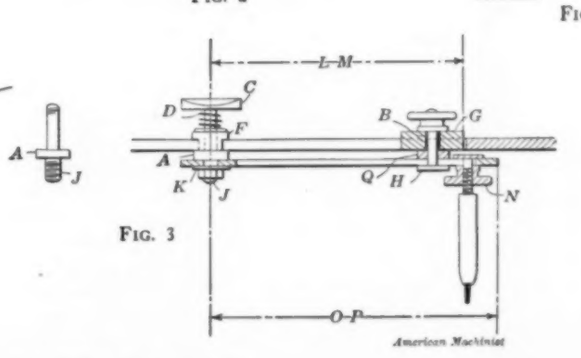


FIG. 3

ELLIPSOGRAPH AND PARTS COMPOSING IT

ing it automatically. Bring the disk *C* to the crossing of the slots, first pressing it down and lifting the pencil clear of the paper, and set the pencil at one extremity of the major axis. Then slacken the adjustable slide, bring the point of the pencil over one extremity of the minor axis, and tighten the slide again. Finally, release your finger from the disk, allowing the pencil to touch the paper, and draw your ellipse.

W. Y. JOPSON AND A. H. DOWNES SHAW.
Cheshire, England.

A Jig for Machining Steady Rests

A jig designed by the firm of Demoor, Brussels, for use in machining their lathe steady rests is shown in Figs. 1 and 2. The lower portion of the steady rest is in position in Fig. 1. Fig. 3 illustrates the type of stay and shows the parts (marked *F*) machined with the aid of this jig. The device is used in connection with stays for lathes of from 200 mm. to 300 mm., that is from say roughly 16 to 24 inches swing. After having been planed the steady rests are secured in the jig, having as a locating point a surface *A* of the same outline as the base. Two small screw jacks *B* and swinging bolts *C* support and secure the steady rest to the base. At the center part *D* a recess of suitable size is provided in the jig, and by its aid dimensions, etc., can be taken by the workman. This also applies to the top part; see Fig. 2. After the stay has been milled, the same jig is taken to the drill (a Barnes horizontal machine being employed) and is mounted on a circular table. Then by means of the table and of the circular movement provided at the base *E*, it is possible to drill all the holes.

London, England. I. W. CHUBB.

A Phonetic Analysis of Machine Shop Sounds

From time to time correspondents quote from local newspapers in different parts of the country, descriptions of impossible accidents, or impossible descriptions of real accidents, but the following paragraph from the pen of a modern writer of industrial and other fiction, will, I think, appeal to the mechanic as about the limit. The "he" referred to is the hero after promotion to the office of superintendent.

"As he sat at his desk now he heard from beyond many closed doors the whir and hum of machinery, the crash of heavy drops, the thudding of distant drills, the scraping and regular clicking of a hundred lathes and automatic machines, the rattle and thump of old-fashioned foot presses mingling with the noise of great power presses like the purring of immense cats."

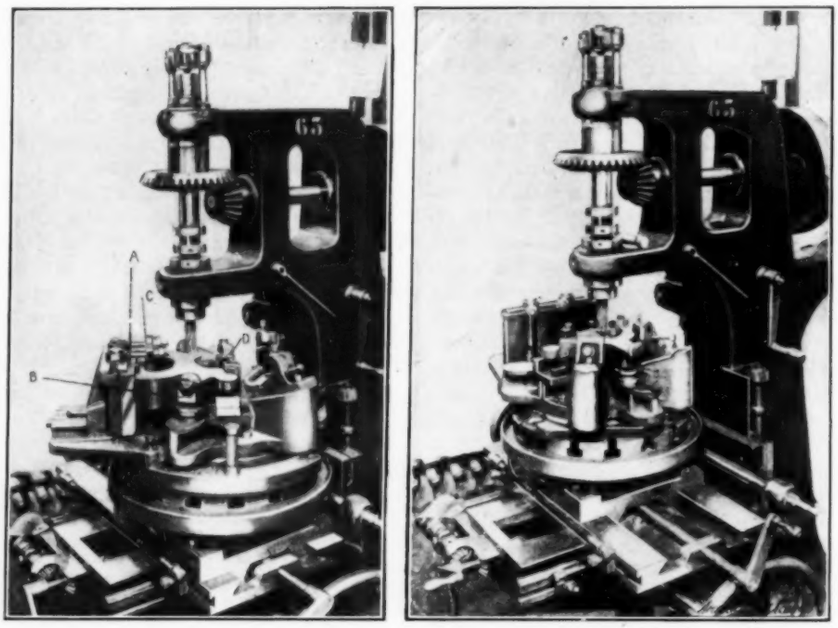
Those drills he heard thudding must have been of the oil-well variety built over for shop use and anyone working in the shop may now be able to understand why the superintendent sometimes looks so cross when he comes out of his office.

I think the newspaper writer may sometimes be excused for inaccuracy of details as much of his stuff is written in haste and under circumstances that admit of little or no references, when the subject happens to be an unfamiliar one.

What excuse a writer in a case like this would have, after taking the time to prepare such a wealth of detail, is a question.

L. L. ARNOLD.

East Greenwich, R. I.



FIGS. 1 AND 2. A JIG FOR MACHINING STEADY RESTS

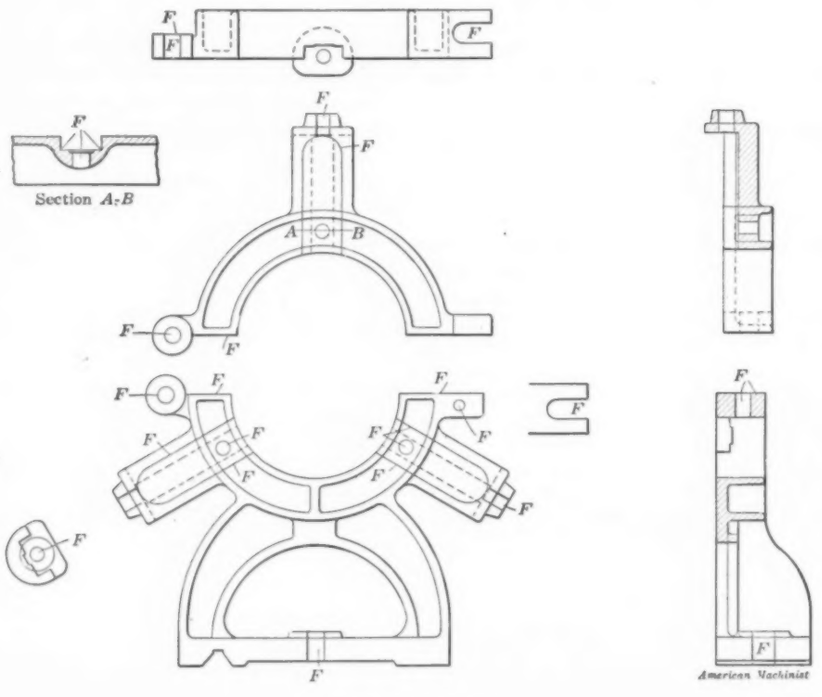


FIG. 3. THE WORK

Compressed Air in Deep Drilling—Adjustable Boring Head

The accompanying sketches show a boring or drilling rig which was used in removing the central core of a number of hollow shafts, and while the rig is one with which many mechanics are, no doubt, familiar, yet the use of compressed air to keep the job free of chips is unique, to say the least.

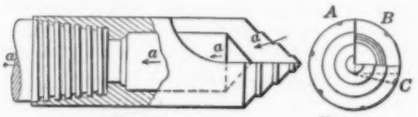


FIG. 1 FIG. 3

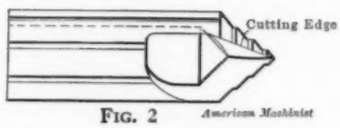


FIG. 2

ACCURATE BORING TOOL WITH COMPRESSED-AIR CHIP REMOVING FEATURE

The drill, or boring tool, is a hog-nosed cutter, shown in Figs. 1 and 2, and is fitted to a hollow boring bar with acme threads, slightly tapered. The bar is made of XXX hydraulic pipe, and finished externally.

The body of the tool has a number of small, half-round grooves cut longitudinally into its surface, *A*, *B* and *C*, Fig. 3, and the cutting edge is stepped to cause the chip to break instead of curling.

The bar is gripped in a suitable holder which is attached to the compound rest of the lathe, and should be in perfect alinement with the job to be bored.

The job to be bored is chucked in the lathe chuck at one end, *A*, Fig. 4, while the other end should run in a steady rest. An extra steady rest is needed to support the piece *F*, which is in reality a stuffing box and head combined. The end of the shaft runs closely against the piece *F*, and the joint between the two is made air and oil tight by the leather ring *G*. The space between the bar and the piece *F* is also made air and oil tight by the use of a U-shaped leather hydraulic packing *H*, which is nearly frictionless.

In operation, the compressed air is led from a convenient source to the pipe shown, and is kept from blowing into the oil reservoir by the check valve *I*. When the air is shut off, the gravity pressure from the oil tank forces the oil, or whatever cutting fluid is preferred, in around the bar and out to the cutting edge of the tool. This shows the use of the grooves *A*, *B* and *C*, Fig. 3.

Air valve *J* is opened every few moments and the air pressure blows the chips and oil out through the tool and hollow bar, as shown by the arrows *a a a*, Fig. 1, and arrow *E*, Fig. 4. Chips and oil are caught in the receptacle placed for that purpose and the oil pumped back to the tank again.

This style cutter and arrangement for oiling makes an exceptionally fine hole, as the chips may be removed almost as fast as they are made, and it insures getting the cutting agent where you want it, as the compressed air squirts it through the small grooves, right onto the surface being cut by the tool.

While dealing with boring jobs, it may be just as well to show a head which I designed and used to bore very long hydraulic cylinders, in a shafting lathe, Figs. 5, 6 and 7.

This rig is one that allows of a very large adjustment, and can therefore be used on different sized work. It can also be used on both roughing and finishing cuts.

It consists of a cast-iron head *M*, Fig. 7, keyed to a hollow bar, as before. Set screws may also be used if desired. *L* is the cutter head proper, and is also of cast iron, fitted with movable blocks which in turn are fitted with hardened rollers *A*, *B*, *C*, Fig. 5. As is shown, the blocks *A* and *C* are not directly opposite each other but are placed so as to be less than full diameter apart. Should the tool *D* wear under a heavy cut, it would naturally bore a smaller hole, but as the rollers *A* and *C* are not at the extremes of a full diameter, they allow the whole head to spring over and still will not bind in the bore, or choke the job.

Sliding blocks *A*, *B* and *C* are fitted with scroll teeth, which fit in the scroll shown in Fig. 6. This scroll lies between *M* and *L*, as at *O*, Fig. 7, and acts the same as a universal chuck, feeding the rollers in or out for small or larger work, as the case may be. The whole is held firmly together with bolts, as at *I*, which go from *M* to *L*, and also allow the scroll to work freely between them. The scroll is locked by use of a set screw *S*.

Just in front of the roller, which will be on the bottom when boring, is placed a small brush, *F*. This brush is set at an angle to sweep the fine chips and dust away from the roller and thus prevents clogging.

At the back of the cutting tool *D* is an adjusting screw *E*, which makes it easy to get your size.

After the job is chucked and running in the steady rest, it is necessary to take a stiff boring tool and start the roughing cut in, say 15 inches. This gives three sizes to which to set your rollers and cutter, and eliminates unnecessary changes.

The rig will work equally well on cylinders of cast steel or cast iron, and owing to the adjustable feature, is one that is of great use.

Compressed air used with this would help a great deal.

Vallejo, Cal. FRANK S. BUNKER.

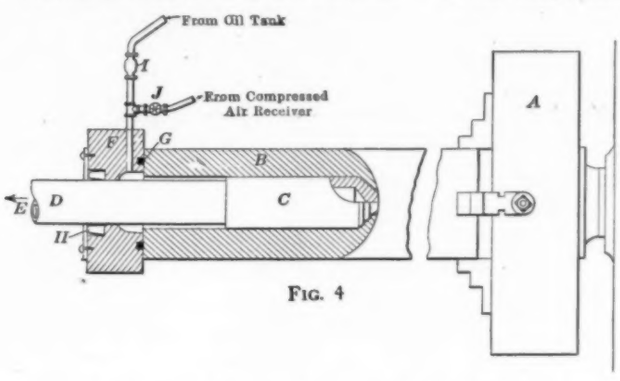


FIG. 4

SMALL ACCURATE BORING RIG AT WORK

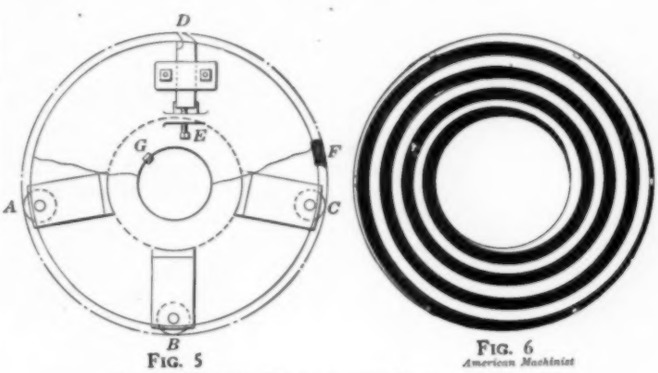


FIG. 5

FIG. 6
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LARGE BORING HEAD WITH GUIDING ROLLERS

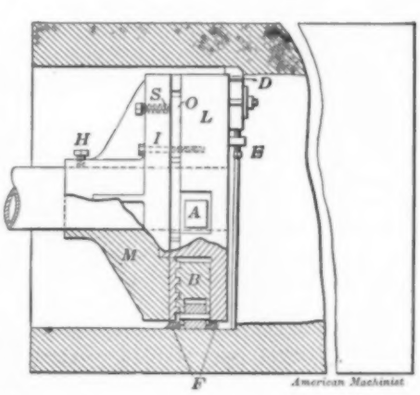


FIG. 7. SECTIONAL VIEW OF BORING HEAD AT WORK

Discussion of Previous Question

Making Cutters for Gear Teeth

In the article by F. A. Stanley on "Making Cutters for Gear Teeth" at page 333, I wish to call attention to the following points:

In the case of the 36-tooth gear and 12-tooth pinion the desired tooth is evidently one of epicycloidal form with radial flank, in other words, the portion of the tooth outline inside the pitch circle is a straight radial line, the face of the

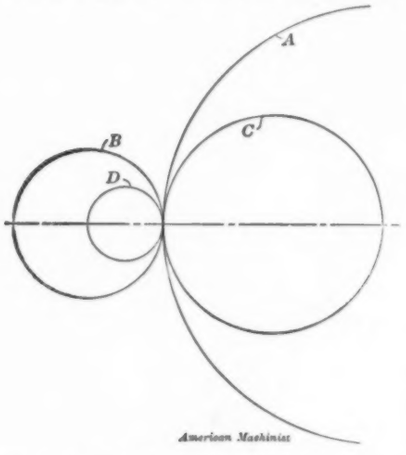


FIG. 1. THE DESCRIBING CIRCLES FOR THE EPICYCLOID

opposing tooth being the proper curve to mesh with it. In order to describe the correct epicycloid to mesh with the radial flank the diameter of the describing circle should be one-half the pitch diameter of the corresponding gear.

Referring to Fig. 1, *A* represents the pitch circle of the 36-tooth gear and *B* that of the 12-tooth pinion; *C* having a diameter of one-half that of *A*, if provided with the marking point as described by Mr. Stanley and rolled about circle *B* would describe the correct curve for the face of the pinion tooth. In the same way circle *D*, having a diameter one-half that of *B* would describe the correct curve for the face of the 36-tooth gear. The use of describing circles equal to the pitch circles of the gear and pinion as described by Mr. Stanley would not give the proper curves for this form of gearing.

In mentioning involute gearing in the last paragraph of his article, Mr. Stanley states that the curve should be described by a scriber in a straight-edge swung about the periphery of the brass disk. This arrangement would not give the correct involute for use in this case.

Referring to Fig. 2, circles *A* and *B* are the same as the corresponding ones

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers.

in Fig. 1. If the involute teeth are to be laid out to the Brown & Sharpe standard of 14½ degrees obliquity, the line *C D* should be drawn as shown making an angle of 14½ degrees with the com-

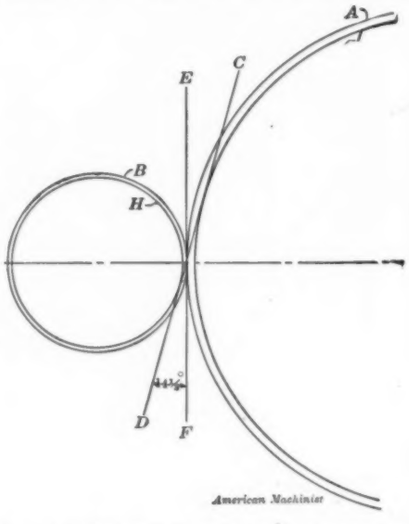


FIG. 2. OBTAINING THE DISK SIZES FOR INVOLUTE TEETH

mon tangent *E F*. The circles *G* and *H* drawn tangent to the line *C D* would then give the size of the disks upon which to roll the straight-edge to describe the involutes.

Waterbury, Conn. J. R. PUTNAM.

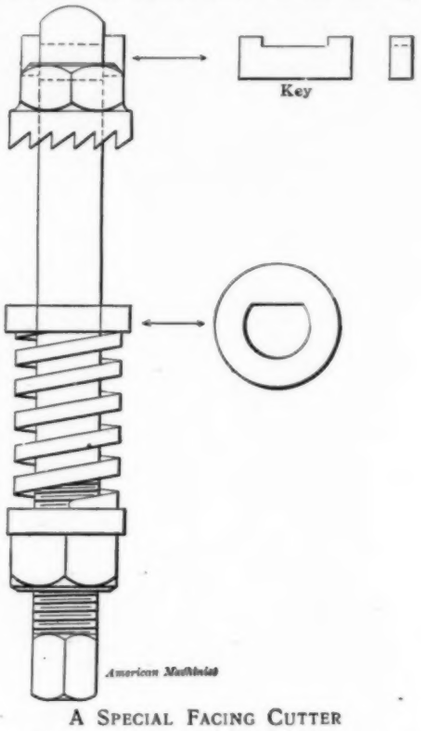
Special Facing Tool

With respect to the facing tool shown on page 314 I think that the cut herewith shows a tool that is an improvement on Mr. Ramsay's single flat cutter.

The cutter in this tool is made of high-speed steel and the teeth cut proportionately strong; the key needs no driving and the whole can be taken apart with nothing but the fingers.

For heavy cutting the wrench can be placed on the hexagon part of the cutter to pull it around. This cutter, having a number of teeth, will face level and not follow the irregularities of the casting as will the flat cutter.

There appeared to be no provision made to prevent the washer and nut from unscrewing on Mr. Ramsay's tool; with the cutter shown herewith a flat or keyway is filed on the screw to suit the flat



A SPECIAL FACING CUTTER

shown on the washer, thus preventing the nut from working off in use.

A. T. SUTTON.

Devonport, England.

The Worcester Trade School

On page 268, George Stuart criticizes Entropy about certain instruction and uses this expression: "That kind of training will not make out of him (the boy) a great man," and I could only wonder after reading it what sort of a world we would have if every man was (educationally) a great man and every woman a Vassar graduate. Ditches have to be dug, bricks toted and dishes washed, and who would do these things? The world has always had these things to do and always will have; it has always had people at different degrees of education and always will have. My belief is that this country has too few so-called uneducated people trained, and plenty of the highly educated.

To carry out the work of the educated engineer requires a lot of men and these men need to be trained. If E. H. Fish

spends the best part of his life or the balance of his life in training the men who would never make engineers, either for lack of money or ability, should he kick them out or make good workmen of them? Will he not be doing as much good to the world to take 10 boys out of the school, and boys who could never for the reasons given, make engineers, and make good, useful workmen out of them, as the college professor who takes that other brilliant boy and makes an engineer out of him?

I know he will not get as much credit for it, or as much glory out of it. Isn't it about time to make a distinction between training and education? Without question, athletics are good for the college student. Is it not possible that handling the jack plane, hand saw and hammer and chisel is pretty good exercise for the boy who is learning to do things and learning to obey orders? Baseball and football are vigorous exercises for the ones who play; but the hundreds of others who "whoop her up" on the bleacheries don't get much more than the ones who dig ditches and carry bricks.

I know full well that I will gain nothing for saying these things; but I believe that what Mr. Fish is trying to do is worth doing and I don't believe this kicking the stupid boy in the gutter is a good thing, as there are boys enough in the gutters now.

Syracuse, N. Y. JOHN E. SWEET.

Threading Sheet Metal Caps

Referring to a paragraph at page 268, regarding tools for screw threading sheet-metal caps as used for metal-polish tins, etc.; the following may be of interest. The threaded chucks, Fig. 1, are as made for thread rolling the necks and caps of petroleum tins, see Fig. 2. The thread is cut the same pitch and slightly deeper than the thread on the caps, the depth depending on the thickness of the sheet-metal used.

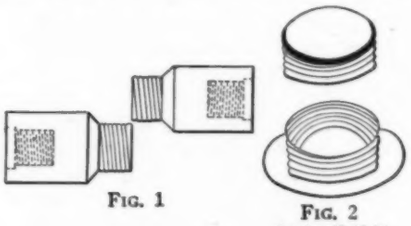


FIG. 1 FIG. 2

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THE CHUCKS AND THE WORK

In operation, these screwed chucks are carried on parallel spindles in left- and right-hand heads in a screw-cap rolling machine, the chuck spindle for the cap being driven by pulleys with both open and crossed belts, for reversing. The pulleys also drive, through suitable gearing, the sliding spindle carrying the upper chuck, the right-hand head being provided with a swiveling arm for supporting the sliding spindle, which is depressed by a foot treadle and powerful toggle motion.

With an automatic machine, however, the upper spindle and arm can be depressed by means of a cam, and held against the lower chuck exactly the same number of revolutions for each, thus insuring uniform work entirely independent of the operator. Again, the automatic movement possesses the advantage of insuring at each operation an equal pressure, thus delivering more perfect work.

These machines are usually built for threading caps from ½ to 6 inches in diameter; with the smaller sizes the necks and caps are put together and threaded at the same time.

The speed at which the chucks are run is from 250 to 500 revolutions per minute, an automatic machine turning out about 70 caps per minute.

It will be obvious that each different size of cap will require a separate pair of threaded chucks.

With suitable tools, trimming and beading plain caps, etc., can also be accomplished on the machine, when not in use for screw-cap rolling.

Glasgow, Scotland. O. SAVILLION.

Self Oiling Pulleys

There have been a number of articles printed in the AMERICAN MACHINIST in regard to self-oiling pulleys, which have interested me considerably, as I have something in this line which is not only original but, I think, ahead of anything in that line that I have seen. My self-oiling pulley is based upon a well known phenomenon of cast iron; to increase in bulk according to the number of times it is heated to a dull red and kept to cool off. But not all know that this process makes the cast iron porous, which becomes very noticeable after being heated and cooled from 30 to 40 times. In my experiments I have found that such cast-iron plates, after being planed on both sides to ¼ inch thick, will absorb a few drops of oil put on top, and show this oil on bottom in less than 5 minutes.

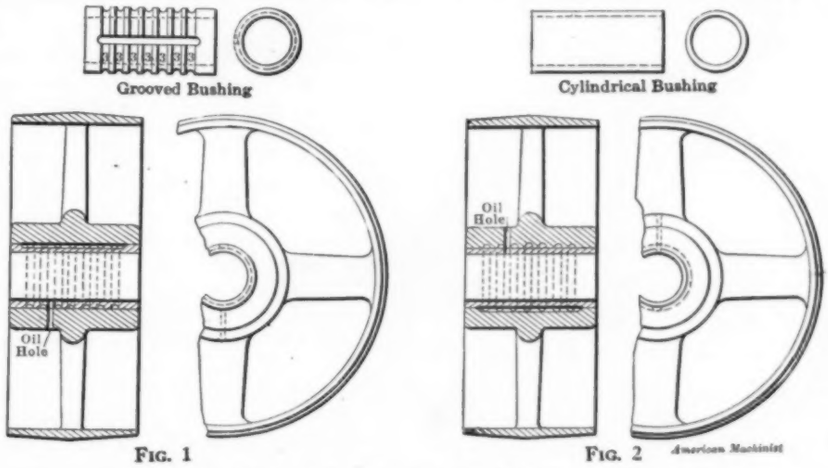

FIG. 1 FIG. 2

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POROUS CAST-IRON BUSHINGS FOR SELF-OILING PULLEYS

This phenomenon of cast iron is that upon which my self-oiling pulleys are based, and to my knowledge it is the first attempt to put it to practical use. The most important part of these pulleys is the bushing which is previously prepared according to the foregoing method, that is; heating to a dull red and letting it cool off, from 30 to 40 times. They are kept large enough to finish to size afterward.

If the scale is removed all over before heating, this will assist the process of becoming porous. Care must be taken to not allow water to come in contact with the bushings after heating, as this will penetrate the cast iron and form oxide, which will destroy the porosity of the metal. These bushings may, however, be immersed in good bearing oil when cooling off for the last time, which will overcome the danger of oxide forming inside.

From the accompanying sketches it will be seen that there are two ways of making these bushings and pulleys. The form shown in Fig. 1 is generally used when the hub of the pulley is too light for that shown in Fig. 2, as in repairing old pulleys. The bushing in this case, Fig. 1, is about ¼ inch thick (they should never be much over that) and has a number of grooves cut around the circumference. These grooves are connected with a lengthwise groove which ends in the outer circular groove on each end.

These bushings are made a good drive fit for the hole in the pulley. The grooves in the bushing, Fig. 1, or in the hub of the pulley, Fig. 2, may be filled with oil when the bushing is being driven in, but I prefer to allow the grooves to be filled by having the oil work through the shell of the bushing. In that way a more fluid oil will be stored in the grooves which will more readily respond to the change of temperature and not gum up the pores of the bushing.

An oil hole is drilled through the hub of the pulley and bushing, to keep the pulley well oiled when first started. Care should be used that the oil hole does not cut into one of the grooves, as that would allow the oil to be thrown out, and not be stored in the grooves, making the pulley useless. In Fig. 2 it will be seen that the circular grooves are cut inside of the hub of the pulley, which allows the bushing to be made thinner; ⅛ to 3/16 inch. The principle is the same as in Fig. 1.

These pulleys should be oiled quite frequently when first started, as the oil will, by capillary attraction and centrifugal force, go through the porous bushing, and fill the fluid oil chambers. Not until that has taken place, will the pulleys be self-oiling. The least change of temperature will force the oil back upon the shaft, and as that occurs instantly, the oil being close to the surface of the bearing contact, it makes an ideal self-oiling pulley.

Making cast iron porous does not in the least detract from its wearing quality. I recently had occasion to take down a loose pulley with 1 15/16-inch hole, which had run between 550 and 600 revolutions per minute with 3-inch belt, over a period of 18 months without oiling. The "fit" on the shaft was as good as when installed, and the hub showed a perfect, shiny surface; the ideal wearing surface for cast iron.

I now have a number of these pulleys running, ranging from 6 months to a year, without having been oiled in that time, and it is needless to say that these are all of the fast running type. I have also tried these bushings on slow running bearings, under heavy loads such as rollers for straightening presses, with equally good results. I consider this the most perfect way of lubrication, when ring oiling cannot be used.

CHARLES PRESCOTT.

North Adams, Mass.

Prevention of Scale in Hardening

I have noted with interest what has been said through your columns regarding the "Prevention of scale in hardening."

There are two very important items that must be considered in selecting and determining the method that will prevent scaling. These are the shape of and use to which the tool is to be put, and the kind of steel that it is made from.

I have seen tools hardened that were not within 99 per cent. of their real value, yet they were pronounced O. K. and accepted; not because they were correct, but because the tool was colored and all in one piece. This latter was always considered a streak of good luck, but today it is different. We have records of some that are astonishing. Think of a drop die that has made 190,000 pieces and is still in use.

In the prevention of scale much depends upon the appliances for heating, as well as upon the heat given. Every hardening room should be equipped with a gas oven furnace. If gas cannot be had it can be made. Right here, the tool hardener is up against a difficult problem, as the manufacturer either shuns the gas bill or fears the gas machine.

Scaling cannot be successfully prevented in the forge fire with any or all of the compounds in existence. The best fire is one that is built very deep and so the tool will be not less than 8 inches from the tuyere iron. It should be built well up the sides and covered with firebrick or an iron cover. If iron, cover with coal and allow the fire to coke up well before putting the tool in place to heat.

Do not subject the tool to more heat than it should have when quenched. This is difficult, in fact it is next to impossible to heat tools in the forge and not subject them to more heat than is required for the hardening. Thus we have over-heating, irregular heating and scaling to contend with.

Next, we have the coke, anthracite-coal and the fuel-oil furnaces. Of these fuels not one is adapted for tool hardening. Here purity and uniformity must be considered and it is just as important to have good fuel as good steel. If either is lacking we cannot have uniformity, neither can we have work free from scale.

Fuel oil is by far the best scale producer. After having operated the fuel oil furnace for a period of six years, I am thoroughly convinced that the saving effected in one year by using gas would equal the cost of an entire hardening plant, including a gas machine.

Coke or anthracite coal fires are so poor as to hardly be placed among the fuels for tool hardening. They, however, are placed in many shops and we must consider their use in preventing scale. The depth of anthracite coal or coke fires should be at least 6 inches above the grates, and on top of this there should be not less than 1½ inches of charcoal. Then by placing iron plates over the top after having leveled off and lightly packed down the fire, a fairly decent heat can be taken. These fires are hard to control, and difficult to fire and hold the entire surface even. It burns through in some parts more than others, thus giving the air a free passage that causes scale, and in many instances blisters.

With gas for fuel and a properly designed oven furnace, the trouble of scaling is reduced to practically nothing. It is then simply a matter of regulating the fire.

Of all the tools hardened about 1/10 of one per cent. must be hardened without scale in the fullest meaning of the term. On these the method pursued is governed by their design and the kind of steel. If for cutting and only the edges are required hardened, the work can be packed in a cast-iron box of sufficient size for the tools to be surrounded by 1½ inches of equal parts of charred leather and pulverized charcoal. After heating the tools to the proper heat, quench the entire contents of the box in water.

If the design of the tool will not permit of quenching in water, the time of heating must be extended in accordance with the size of the work and the tools quenched in oil. This will vary from 30 minutes to two hours of continued heat, after having reached the quenching temperature. Never raise the temperature above that desired for quenching during the prolonged heating.

If the tool to be hardened is for embossing or work that must be hardened to sufficient depth to withstand a severe blow, or a great strain, the heating may be continued as above, but the cooling must be changed from the milder to the more violent.

In some instances it will be necessary, when quenching, to use a heavy stream of water with a good pressure. It is then necessary to hold the work in tongs and the piece must be lifted from the box with enough of the packing mixture to cover the working side of the tool.

Where this cannot be done, the piece can be wired so as to permit its being handled from the wire. Then by holding the box close to the stream and drawing the work out of the box by the wire it can be plunged into the water instantly.

I am not much in sympathy with the above method of heating and on embossing dies, where but one side is to be protected, I cover the face with all the pulverized charred leather that will lie there. Then by heating and removing from the fire carefully, I am able to plunge the piece under the stream of water without removing the mixture from the face of the die.

Again, if I have a piece that does not require the greatest possible care, I heat it to a blue, then plunge it into a very strong solution of salt water. By removing from the fire with sufficient heat to cause the water to boil, it leaves a coat of salt that will adhere when placed in the lead. As soon as the heat on the piece in the lead bath reaches 1420 degrees Fahrenheit, the salt will melt and form a coat over the entire piece and thus prevent the air from coming in contact with the work.

In conclusion, in order to prevent scaling, use a furnace that will produce the best possible combustion with the very best and purest of fuels, which is gas.

M. E. HOAG.

Beloit, Wis.

A Direct Drive for Automobiles

By Chas. H. Logue

A bevel-gear transmission which avoids sliding gears and puts all the weight of gearing on the driving axle.

The illustrations show a new drive for automobiles or trucks which employs no sliding gears to secure the desired change.

Fig. 1 shows the transmission made by the Collins Axle Company, Pittsburg, Penn., having two speeds forward and reverse, designed for light pleasure cars and taxicab service. Referring to Fig. 2, the driving shaft direct from the motor carries two pinions *A* and *B*, which are constantly engaged in the driven gears *C*, *D* and *E*, gear *E* on the right being of the reverse movement. Power is taken from the hubs of these gears; there is no disengaging of the teeth, no sliding keys, no hollow shafts, little or no noise when engaging clutch jaws, as their construction and relatively slow speed enables this to be accomplished with little pressure on the controlling lever. Also speed may be attained directly, without moving the clutch through another set of jaws. These clutches, when engaged, also give an additional bearing support to the gear they are driving.

A common source of trouble in a bevel-gear drive is the end thrust caused by the action of the teeth. This thrust allows the driven gears to push partially out of mesh, rapidly destroying the teeth by throwing the load on the small end and disturbing the ratio of the pitch of the teeth in contact.

In this transmission this thrust is carried by the pinion *F* placed opposite the pinion *A* and engaging both the low-speed and the reverse gear. This pinion not only counteracts the thrust, but maintains the alinement of the entire transmission and makes a quieter, smoother drive.

The weight of the two-speed transmission is 125 pounds and that of the three-speed 150 pounds. By loosening the pinion-shaft coupling the entire transmission may be removed through the opening in the rear-axle case. Gear troubles are, therefore, localized.

Fig. 2 is a sectional view of the two speed transmission; the single-lever control is also illustrated. The rod *X* on the right operates the clutch for the reverse gear *E*. The rod *Y* on the left operates the clutch for the high-speed gear *D* and the low-speed gear *C*.

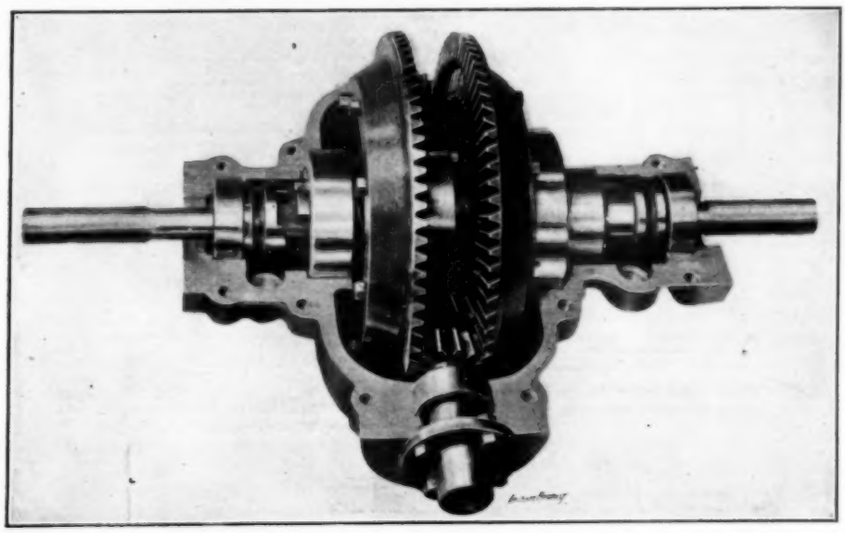


FIG. 1. THE TWO-SPEED TRANSMISSION

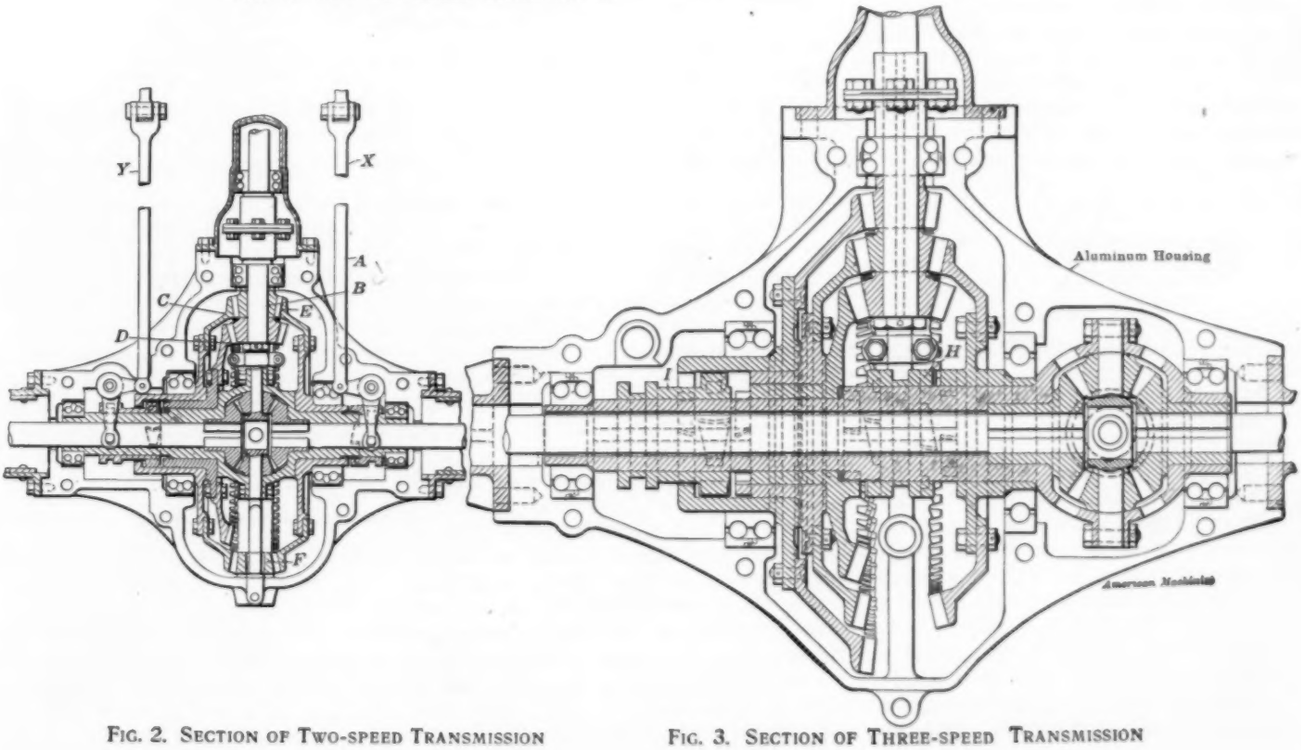


FIG. 2. SECTION OF TWO-SPEED TRANSMISSION

FIG. 3. SECTION OF THREE-SPEED TRANSMISSION

On the three - speed transmission, shown in Fig. 3, the clutch *H* engages the reverse gear when moved to the right and the high-speed gear when moved to the left. The clutch *I* engages the second and low-speed gears in the same manner. The differential gears are placed to the right of the bevel gers, the only difference this makes is a variation in the length of the shafts carrying the power to the wheels.

The difference in rotation between the bearings on the forward speed gears is so slight as to create little frictional loss.

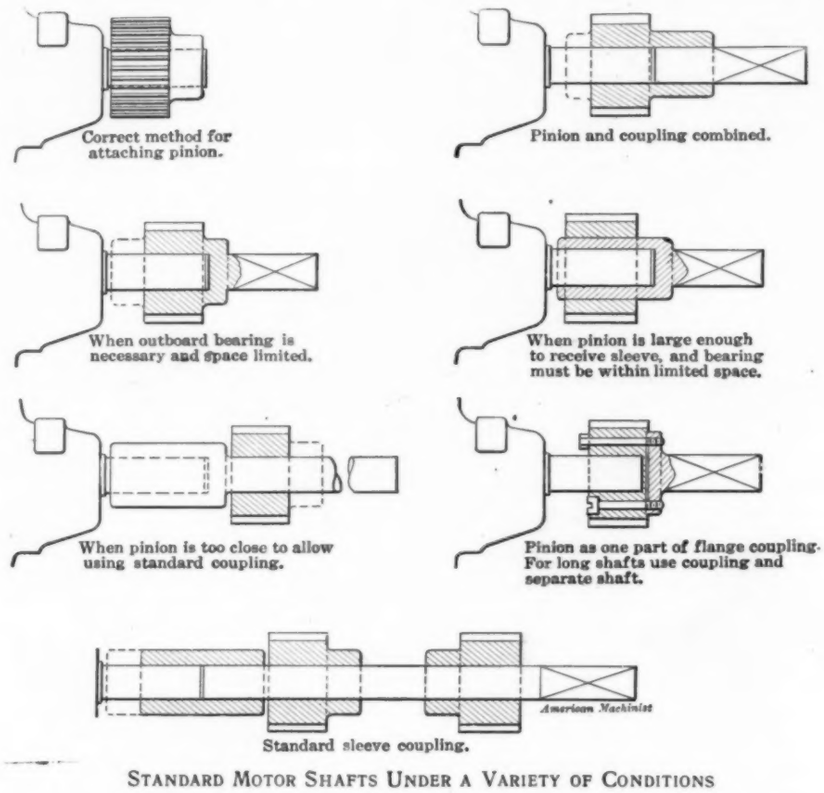
One of these gears has been driven over 5500 miles in the mountains of western Pennsylvania, doing better work than a regular transmission of much higher ratio, which indicates a higher efficiency between the motor and the wheels. Only the high-speed gears are hardened. It is believed that for taxicab or truck service, this form of transmission has several advantages.

Standard Shafts for Electric Motors

It is not necessary to enlarge upon the advantages due to the avoidance of special armature shafts for electric motors attached to machine tools and other machines. Convenience in the interchangeability of armatures reduces the number of spare armatures to be carried and makes it possible in emergencies to take an armature, or even an entire motor from an idle machine to run one which must be kept going. Moreover, restricting the shaft to stock patterns enables the motor manufacturers to supply motors from stock, without the delays involved in making special shafts.

The practicability of this restriction is shown by the fact that of a total of more than 5000 individual drive motors in the Schenectady works of the General Electric Company there are scarcely more than a dozen with special shaft extensions, absolutely standard pulley shafts being used for all ordinary lathes, planers, shapers, milling machines and other machine-tool drives.

The accompanying line engraving shows a variety of constructions used at the Schenectady works, in order to locate driving pinions at points suitable for the machines to be driven, and at the same time retain the standard shaft length, and there seems no good reason why the same, or similar constructions which avoid special shaft lengths, should not be used to the practical exclusion of special shaft dimensions. In addition to the construction shown various forms of flange and split couplings are used, but these do not require special illustration.


Correct method for attaching pinion.
Pinion and coupling combined.
When outboard bearing is necessary and space limited.
When pinion is large enough to receive sleeve, and bearing must be within limited space.
When pinion is too close to allow using standard coupling.
Pinion as one part of flange coupling. For long shafts use coupling and separate shaft.
American Machinist
Standard sleeve coupling.

STANDARD MOTOR SHAFTS UNDER A VARIETY OF CONDITIONS

Milling a ⅞-inch Concave Groove with a ½-inch Convex Cutter

BY W. MCARDELL

At times the small repair shop is hard pressed when an unusual job comes along. Many and varied are the means conjured' up to get around a hard spot.

Recently in a shop where I am employed, it was required to mill a groove, several inches long, to have an arc of a ⅞-inch circle, necessitating the use of a 7/16-inch radius milling cutter.

The nearest cutter was one having a ½-inch convex face. As a start had to be made we ran this cutter through the work about the right depth, three-sixteenths of an inch, intending to make a fly cutter to finish the job.

The milling hand, who had been doing some hard thinking, after the cut was over suggested that the table be swiveled a few degrees and the cutter passed through the groove again. He reasoned that the cut could not get any deeper and would get wider.

This was worth while trying and we found that when the table was over 12 degrees, the arc approximated a ⅜-inch radius circle and at 18 degrees we had a curve which, while it let in a little light at the ends, was very near to having a 7/16-inch radius. A few touches with a riffle file completed the job.

An analysis of the principle underlying the operation would seem to indicate that the curve generated was the same that would be produced at the small ends of the ellipse formed when a plane is passed through a cylinder equal in diameter to the cutter, at the angle mentioned.

The consensus of opinion was that the arc on the edge of the cutter ceased to be much of a factor in generating the curve, although, of course, it made the groove wide. It would also appear that were the vertical milling attachment used in connection with an end mill, the curve produced would be the same as that portion of an ellipse lying on either side of its major axis.

A good flux for use in brazing cast iron can be made by mixing one pound of boric acid, four ounces of pulverized chlorate of potash and three ounces of carbonate of iron. To make a good brazed joint the metal should be carefully cleaned and the pieces heated to a bright red before applying the flux.

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American Machinist

Editorial

The Translation of Educational Terms

The article which we publish elsewhere in this issue on "The Training of Mechanics in Germany," explains in detail the manner in which mis-translation, or misunderstanding of words translated from German into English has led to an almost universal misunderstanding of fundamental facts, and incidentally it shows a difficulty in translations on educational topics which is, we believe, not equaled in any other field.

The cases cited are but illustrations and it may be worth while to give two others from an article which will appear in a later issue on the apprentice school of the Ludwig Loewe Company.

In naming the trades to which boys are apprenticed in those works one of those given is locksmithing. Here certainly is a word which seems incapable of mistranslation or misunderstanding, but the German context shows that the natural understanding of the word is entirely erroneous, and, as a matter of fact, as referred to in this article, the locksmith apprentices have nothing whatever to do with locks. We are not, in fact, able to make out just what they do do, except in a general way as indicated in the footnote to the article.

A still more striking case lies in the use of the word German as a subject of study in German industrial schools. This subject is, by law, compulsory in all such schools, and it appears repeatedly in every schedule of their work. With our understanding of the word as referring to the study of the German language, composition and literature, one would be forced to the conclusion that students in German industrial schools devote a vast amount of time to the study of their native language. As a matter of fact, the word, when used in this connection, has no such meaning, nor, indeed, anything that seems to be related to it. So wide is the list of topics which appear under this heading that we are not able to find words for describing it, nor is it possible for an English speaking person to understand how the word is used as it is used. That our readers may understand how far the, to us, natural understanding of the word is from its true meaning, we give the following partial list of subjects which are included under the classification "German:"

The apprenticeship agreement and its dissolution; apprenticeship in the time of the guilds; relation of the journeyman to the employer, his rights and duties; military service; coast defense; accident and sickness insurance; patent and trade-mark law; the workshop and its construction, heating, ventilating and lighting; electric signals; telephones; safety guards; emergency service; welfare arangements; iron and steel, their production; copper, tin, zinc and their alloys, and much more of the same character.

These things will serve to illustrate, though they do not explain, why the German system of industrial education has been so widely misunderstood. There is, we believe, no subject on which it is so difficult to make one's self understood or to understand others. No question should be asked less than three times, and even then one will get answers by different persons which are irreconcilable. The explanation lies largely in the fact that the discussion of educational topics deals chiefly with generalities. In such cases it is difficult enough for one to make himself understood in his own language, and almost impossible when dealing with another.

Regardless of the explanation, the fact stands that in spite of all that has been written and said about German industrial education in this country, it has been misunderstood to an extent that would be laughable if it were not so serious. We believe that the article which appears on another page is the first to be printed in this country, if not in the English language, which really sets forth what that educational system is, what it does and especially what it does not do.

Where Do Old Machine Tools Go To?

One of the major articles in this issue is on a most important subject, "The Depreciation of Machine Tools." A statement of interest is that machine-tool scrap is almost unknown in the average foundry, although textile machinery, printing presses and agricultural machinery furnish a considerable proportion.

Add to this statement the fact that second-hand machinery dealers can apparently always find a market for any machine tool that is offered, with the possible exception of one that is extremely large, and we may well argue: Are not machine tools unique in that no matter what their

age or condition there is always a "sphere of usefulness" for them?

From our own experience in connection with several installations aggregating some 10,000 machine tools, we can recollect only a bare half dozen that were junked. At the same time many hundreds were sold because they were of an old design, or ill adapted for the work they were used on, or for some other sufficient reason; and there was no difficulty whatever in disposing of all of these machine tools.

The average life of a locomotive is said to be nine years; it is not unusual for the entire equipment of looms in a textile factory to be scrapped to make room for better machines; some types of printing presses, particularly the very large ones, must be converted into junk when they are discarded, for no one needs them. A machine tool, on the other hand, can step down from the highly organized manufacturing department to the humble repair job, and then to the small job shop and be useful in each place, and perhaps permanently escape the foundry scrap pile.

If such is the life course of the average machine tool, is it not pertinent to suggest that there are perhaps more antiquated machines in use than we have any idea of, and that there are many machine tools in use today that according to the rules of depreciation should have ended their careers many years ago? And again, what influence has this large number of old machine tools in our shops today upon the efficiency of the machine-building industry in general?

An old machine tool may seemingly satisfy the needs of the small shop, but no argument is needed to prove that a more modern tool would be more effective if properly handled, even under the changing conditions of work of the small shop. Is it not worth while to consider increasing the foundry scrap pile at the expense of some of the machine-shop equipment?

Unnecessary Delays and Slow Machines

There are two sides to every question according to the old saying. To save time in the shops is to cut out delays, and there are, to generalize, two kinds of delays, or losses of time; lost time in the operation of the machines and unnecessary attendant delays that reduce the number of hours and minutes that a machine is actually cutting metal.

Replacing a slow machine by a faster one will do away with machine delays, and a study of handling materials and tools will show how to reduce the others. Often the latter are much greater than the former, yet they can be corrected with no expenditure for additional equipment.

Again, time losses are often due more to unnecessary delays than to slow machines.

Research Work in Sibley College

Previous to 1900, the Department of Experimental Engineering of Sibley College was able to conduct numerous investigations, and the reports of these various investigations formed a considerable portion of the transactions of the American Society of Mechanical Engineers. Dr. R. H. Thurston, who was the first director of Sibley College, and was the head of the college from 1885 until his death in 1903, made, personally, numerous investigations, which even today are the sources of much of our knowledge respecting the coefficients applying to various branches of engineering information. Doctor Thurston advocated research and investigation, not only for the purpose of advancing engineering practice, but also as a means for obtaining an engineering education.

The growth of Sibley College has been so rapid as to require the entire time of all the professors and practically all of the equipment and room for the last 10 years.

Now, however, Director Smith has proposed a plan which it is believed will, in the course of a few years, bring Sibley College prominently before the engineering world for its work in research and investigation. The plan in brief is to devote a portion of the force of the Department of Experimental Engineering to investigation. The plan is to relieve them from instruction work. The scheme is to be worked out as follows: Professor Carpenter will be relieved of education work in connection with the mechanical laboratory and will devote his time to engineering research, except such as may be needed for the special courses of instruction in heating and ventilating and in motor cars, which he will give during the second term. Professor Diederichs will take full responsibility for the instruction work in the mechanical laboratory. He will also give a special course in Refrigeration.

The room, apparatus and money available for research and investigation work this year are not large and consequently the immediate returns will not, perhaps, be very great.

It is proposed as the preliminary work of the Research and Investigation Branch, that the records of the past investigations which are meritorious but which have not been published, will be compiled and prepared for publication as soon as possible. The *Sibley Journal of Engineering* is to be made the official organ of these publications, and the readers of this journal can expect at least one article a month, giving the results of investigation and research work, which have been conducted at Sibley College.

Examination for Mechanical Engineer

On November 26, 1910, the State Civil Service Commission of New York will hold an examination for mechanical engineers, transportation department, Public Service Commission, first district, $2401 to $3000.

Application blanks must be filed on or before November 19, 1910, which can be obtained from the commission at Albany, N. Y.

PERSONALS*

Frank W. Magin, connected with the New York office of the Allis-Chalmers company, has been transferred to headquarters at Milwaukee, to act in the capacity of selling engineer.

E. R. Evinger, formerly with the National Automatic Tool Company, of Richmond, Ind., has accepted the position of superintendent of the Miami Valley Machine Tool Company, Dayton, Ohio.

Frank Kibitz, for a number of years connected with the Howard Iron Works, Buffalo, N. Y., resigned and is now with the Standard Mirror Company, of the same city, to design new machinery.

Louis L. Johnson, until recently with the Southern Pacific company, San Francisco, Cal., has established himself in business in Indianapolis (Law building), as a consulting engineer, specializing in gas power and fuel plants.

Albert S. Merrill, until recently assistant inspecting engineer of the Universal Portland Cement Company, Chicago, Ill., has joined the faculty of Lafayette College, Easton, Penn., and is in charge of the general testing laboratory.

W. H. Cameron, chief engineer of the Willys-Overland Company, sailed for London, October 19, to attend the Olympia show. Before returning, Mr. Cameron will tour the continent for a month, visiting various continental factories, and investigating foreign motor conditions generally.

A special issue of *Grits and Grinds* commemorates the twenty-fifth anniversary of the Norton Company and the tenth anniversary of the Norton Grinding Company, Worcester, Mass. It was issued principally for distribution among the 1200 employees and is largely devoted to them. Three men have been with them since the start, while thirty-three have passed the twenty-year mark. This issue is largely a tribute to those who have helped build the Norton Company to its present magnitude and should prove another tie, which will do much to maintain the spirit of coöperation that has been an important factor since the beginning.

*Items for this column are solicated.

New Tools and Shop Appliances

The Barber-Colman Gear Hobber

The accompanying illustration shows a No. 12 gear hobbing machine manufactured by the Barber-Colman Company, Rockford, Illinois.

This machine is designed for use in manufacturing work where rapidity of production and accuracy of product are of equal importance. It is strictly a manufacturing machine for cutting spur and spiral gears such as are required in the manufacture of modern machine tools, automobile transmissions, etc. The capacity is 12 inches diameter, 4 diametral pitch, 10 inches face.

The idea in designing it has been to produce a gear-hobbing machine with the features that have gone to make the ordinary rotary cutter type of gear-cutting machines so satisfactory. The illustration shows how this has been carried out. Particular attention should be given to the fact that small gears can be held on the work arbor close to the spindle while the outer end of the arbor is supported. This is necessary in order to produce gears of a uniform size.

The long bearings possible insure continued accuracy of alinement of the work arbor with the hob slide, and provide practical means of adjustment in case of wear. This feature is important where accuracy of product is desired, as a quiet running gear cannot be obtained on a machine in which the alinement of hob slide and work spindle is not maintained.

The hob or cutter slide is horizontal with long narrow guiding ways, taper gibbed and can be easily adjusted or swiveled to the correct angle.

The axis of the hob intersects the vertical axis of the swivel so that the hob may be set central with the work spindle when at right angles to the latter or in other words when the swivel is set at zero, and may then be swiveled to the angle desired, exactly in the manner that would be employed in setting for spirals on the milling machine.

The lateral adjustment of the hob is obtained by a slide on the swivel, which is capable of sufficient movement to allow of several teeth in the hob being adjusted to the center so that the maximum amount of work may be obtained before sharpening of the hob is necessary. The swivel is capable of angular adjustment of 45 degrees on either side of zero and is provided with a vernier reading to ten minutes. A micrometer dial is provided for setting the hob to depth.

Both work and hob spindles are provided with conical bearings so that practical means of adjustment in case of wear are provided. All bearings are bushed with bronze and special attention has been given to the lubrication.

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

Special facilities for taking care of the chips are provided, a removable chip basin being placed in the bed to which all oil and chips are conveyed. The lubricant for the hob is contained in a tank cast integral with the bed and an oil pump is connected as a part of the machine.

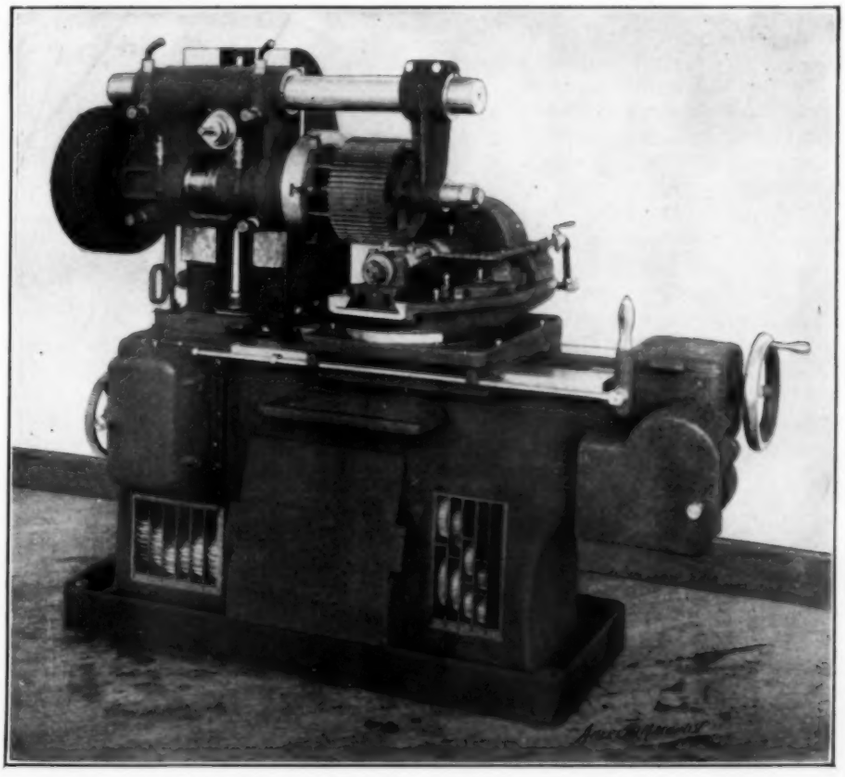
The drive is of the direct single-speed belt type, 14-inch tight and loose pulleys being provided for three-inch belt to run at 300 revolutions per minute, making it possible to belt direct from the main line or from a motor as desired. The speed changes are obtained by transposing gears on the front of the machine. The feed is positive and any desired rate may be obtained by change gears. The feed of the hob slide is automatically tripped as desired at any point of its travel.

A single set of change gears govern the number of teeth and pitch of spiral to be cut and are located at the rear end of the machine.

The construction is of the highest grade, the bed and upright are of box section, rigid in construction and all parts are easy of access.

The equipment consists of necessary change gears for hobbing all gears ordinarily encountered, speed and feed change gears, wrenches, charts and feed tables.

The net weight of the machine is approximately 3700 pounds.



THE BARBER-COLMAN GEAR-HOBBING MACHINE

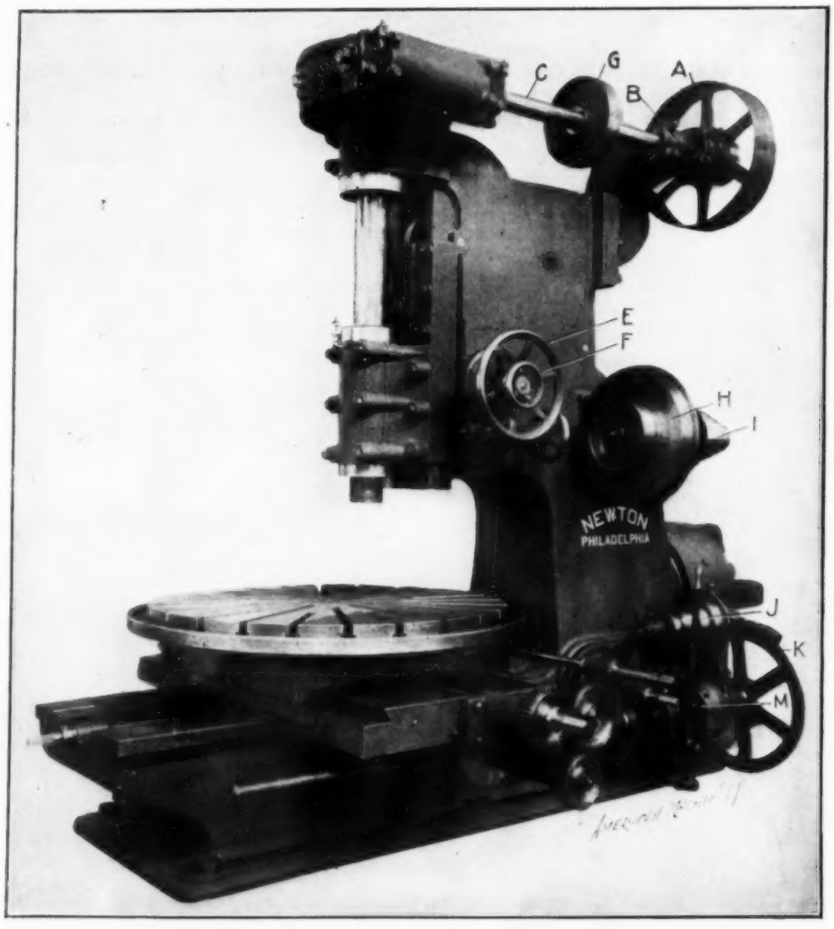
Vertical Milling Machine with Worm Drive

The halftone illustrates a new design of vertical milling machine, built by the Newton Machine Tool Works, Inc., Philadelphia, Penn.

The frame is a single casting and all gears are cut from steel. The spindle is 6⅜ inches diameter in the main bearing, which is 21½ inches long. The driving worm wheel is of very large diameter, has a bronze ring with teeth of steep lead. The sleeve rotates in a bushed-capped bearing, which is bolted to the top of the frame to permit adjustment. The spindle is driven with the sleeve by means of a double keyway.

The drive is taken from a General Electric 220 volt, 30 horsepower motor, having a speed of from 400 to 1200 revolutions per minute through a 7-inch belt to the pulley *A*, which turns on the finished end of the bearing *B*, in order to give a large wearing surface. The rotation of the shaft is obtained by keying a large washer on to the shaft, which has a broad-face key extension fitting into a corresponding slot in the end of the pulley hub. The driving worm is of hardened steel, fitted with roller thrust bearings. It is fitted to the shaft *C*. The driving worm and worm wheel are entirely incased, permitting of continual lubrication. At *E* is shown the method of obtaining the vertical fast-hand movement and also the hand slow adjustment by engaging or disengaging the clutched hand wheel *E* by the small combined nut and hand wheel *F*. Motion for the feed is taken from the pulley *G* to the two-step cone *H*, to which is attached a four-step cone of smaller diameter, which is belted to one of equal proportions at *J*. Motion is further transmitted through the large gear *K*, which rotates freely on the horizontal driving shaft, and feed can only be obtained by the engagement of the lever *L*, and when in its opposite position fast traverse is available. The feed and fast-power motions are further carried through the double train of bevel gears, giving reverse to both motions for the circular, in and out and cross movements. All gears on this machine are of steel or bronze and all movements are clutched. The circular table is 60 inches in diameter over the *T* slots, entirely surrounded by an oil pan, is of very heavy construction and has an exceptionally large central bearing in the table saddle. The cross saddle has square lock gibbed bearings on the base. Adjustments are made by means of taper shoes.

The maximum distance from the end of the spindle to the table is 22 inches, length of in and ou feed 33 inches, length of cross feed 33 inches and distance from center of spindle to upright 34½ inches. The machine occupies a floor space of about 12 feet 2 inches by 8 feet 5 inches, with an additional extension of 5 feet in the rear for motor when arranged for motor drive. The extreme hight with the spindle in its highest position is 12 feet 6 inches.



VERTICAL MILLING MACHINE WITH WORM-DRIVEN SPINDLE

A Carborundum File

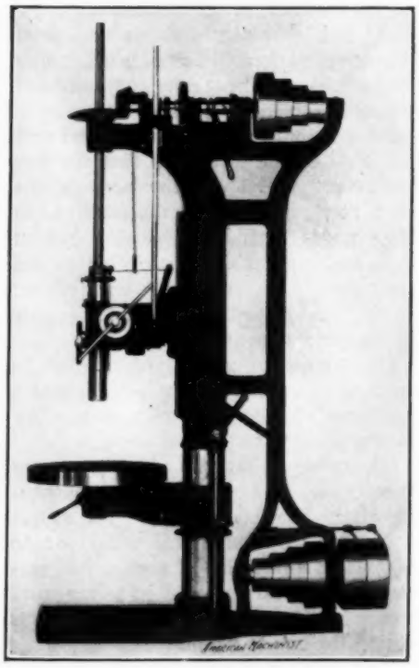
The carborundum file shown in the halftone is a solid block of carborundum 13 inches long, 1½ inches wide, and 1½ inches thick. One end is rounded, and the other fitted with a durable wooden handle. It is for filing castings, or soft metals as well as for touching up case-hardened parts and removing the scale from the harder metals.

A CARBORUNDUM FILE

It is made by the Carborundum Company, Niagara Falls, N. Y.

An Upright Drill with Geared Feed

The halftone shows a 28-inch drill press having positive geared feed with which the Sibley Machine Tool Company, South Bend, Ind., will equip their entire



AN UPRIGHT DRILL WITH GEARED FEED

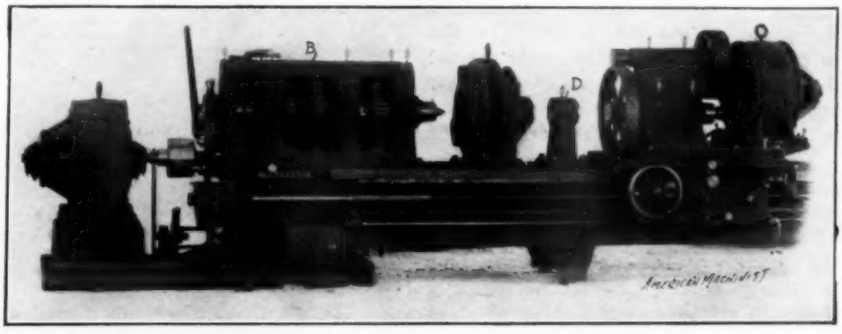
line of drill presses above 20 inches swing. Power is derived from the top shaft through spur gears from which it is transmitted by spiral gears to the vertical feed shaft. The gear case is partially filled with oil, insuring thorough lubrication. The feed box is located on the head and is of the sliding-key type, giving four changes and a neutral position. The changes are controlled by a small knob in the center of the hand wheel. An automatic stop collar on the sleeve of the spindle throws the latch which holds the feed worm in mesh with the bronze worm gear and the entire mechanism swings out of operation.

Lodge and Shipley Axle Drilling Attachment

The Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, has recently completed a special drilling attachment, applied to one of their 30-inch by 30-foot motor- driven patent head lathes, to drill 4-inch holes longitudinally through the centers of steel axles 10 inches in diameter.

The cut shows a front view of the lathe, with some of the gear covers removed to show the gearing of the headstock and of the special drilling attachment on the carriage.

To take care of the end thrust required to drive a 4-inch drill, the headstock is provided with a special tie-piece *B* across the top, fastened to the caps of each one of the four bearings. The headstock gearing gives six mechanical changes of speed, which are supplemented by a 2 to 1 speed variation in the 10 horsepower main driving motor.



LODGE & SHIPLEY AXLE-DRILLING ATTACHMENT

The drilling attachment *C* is mounted upon the carriage. It consists of a heavy bracket with a train of gears driving from a direct-connected variable-speed motor of 4¼ horsepower. The main driving shaft in this bracket carries the drill in alinement with the lathe spindle.

The lubricant is forced through telescopic piping at the back of the bed up to the center of the main driving shaft of the drilling attachment and then passes through the drill itself and is discharged at its tip. The telescopic piping insures proper lubrication of the drill, regardless of the location of the carriage. The whole machine sits in a pan (not shown) to retain the lubricant and chips.

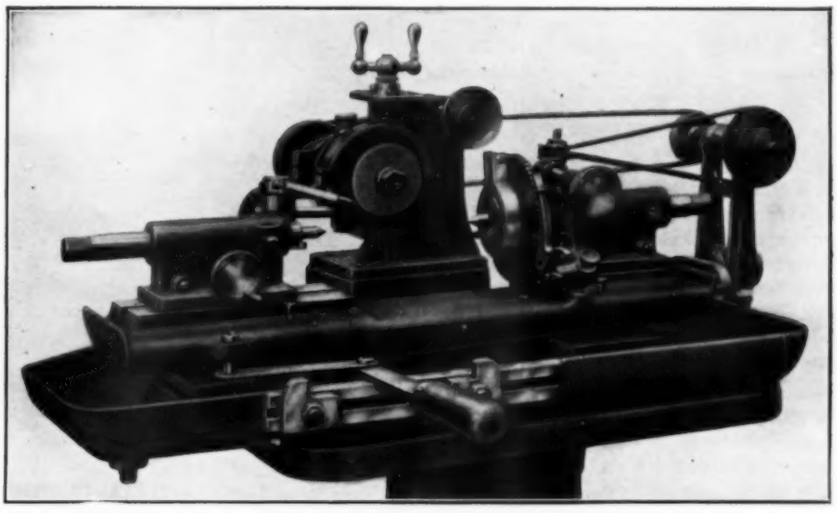
One end of the axle to be drilled is gripped in a chuck (not shown) on the lathe spindle, and the other end is carried in the special steady rest *A*, between the headstock and the carriage. That portion of the steady rest which carries the end of the axle has a large annular bearing within the circumference of the steady rest, so that this portion of the steady rest revolves with the axle. The other side of the steady rest carries the drill in a bushing which revolves with the drill. Between the steady rest and the carriage is a drill rest and guide *D*, with a revolving bushing to support the drill at about the center. These bushings, while free to revolve, are kept from movement endwise by a set screw, the tip of which enters an annular groove around the center of the bushing.

Thus the work revolves in one direction and the drill in the opposite direction, giving accuracy and high production.

Hob Grinding Machine

The illustration herewith shows the new hob-grinding machine manufactured by the Meisselbach-Catucci Manufacturing Company, Newark, N. J., the important points of which are that the teeth are ground radially and, there is an abundant flow of water supplied to prevent the burning of the edges of the cutter being ground.

Means are provided for quickly setting the face of the emery wheel radial with the work. The face of the wheel is ground perfectly true by a simple fixture for holding a diamond tool. The cooling water is under control at all times and can be increased or diminished and directed at proper points of the work. Guards are provided for confining the water; at the same time, however, the work is in full view of the operator.



HOB-GRINDING MACHINE

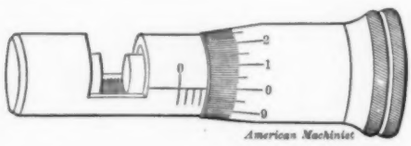
The teeth of the cutter being ground are not depended upon for the spacing required in grinding them. The work is independently redivided by a large index plate on the machine, and inequalities caused by hardening or uneven wearing are corrected. The arbor holding the work revolves on two dead centers to eliminate chances of being out of true.

While primarily designed for grinding straight fluted hobs for cutting gears of the smaller pitches, an attachment for grinding spirally fluted hobs can be supplied. Gear cutters, forming cutters, screw machine round forming cutters, taps, and similar tools can also be ground.

The machine will accommodate diameters up to 5¾ inches and is equipped with a one-speed overhead countershaft and all necessary wrenches.

A Micrometer for Measuring Wire

The line cut shows a compact little micrometer which is made by Paul



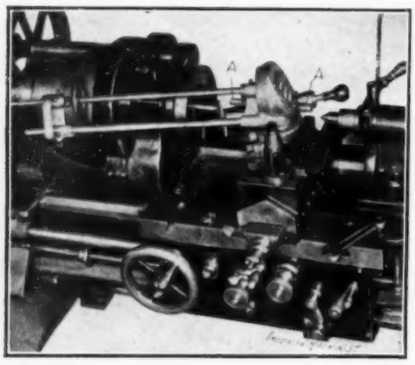
A MICROMETER FOR MEASURING WIRE

Rückert, Gera, Germany. It is intended for measuring wire and small rods.

A Lathe Center Grinder

The halftone shows the grinder mounted in the lathe. The drive is obtained by means of a rubber friction disk *B*, held in contact with the lathe cone. The driving shaft is held rigid by an auxiliary or supporting shaft; and the two are united by a single casting, which also provides the friction-driving disk bearing, and at the same time provides the handle by means of which the operator holds the friction disk in contact with the lathe cone. The power from the driving shaft is transmitted through a bevel gear and bevel pinion to a pair of spiral gears, which, in turn, drive the grinding spindle. The bevel gear and pinion drive enables the operator to swivel the upper gear housing around to any angle, without affecting the drive.

The center locating lugs *A*, on the main base casting, are fitted with hardened



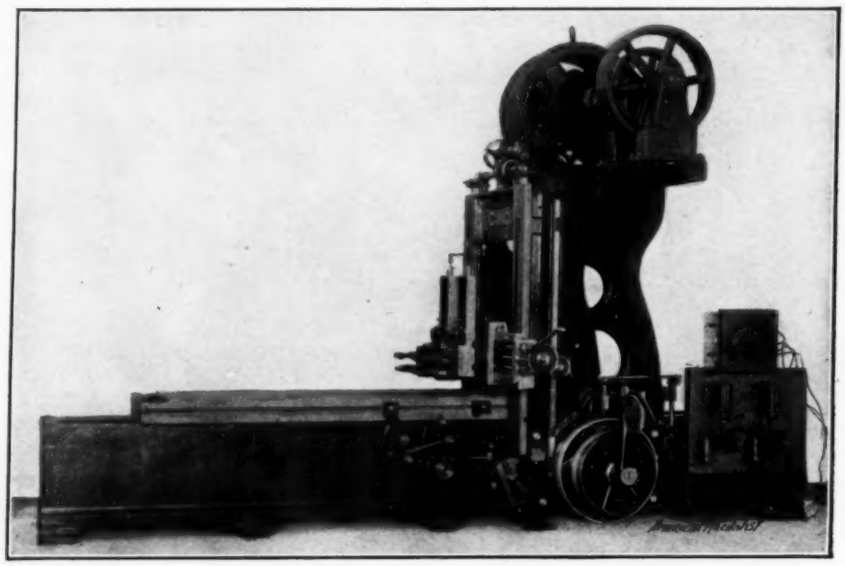
A LATHE-CENTER GRINDER

tool steel centers for mounting it between the head and tail centers in the lathe when setting. While the centers hold the main casting in this way at 60 degrees, the tool-post holder is clamped tight in the tool post, thus locking the angle setting, after which the tailstock is removed and the further manipulation of the machine is carried on by using the lathe carriage and its cross slide.

This center grinder is made by Wilmarth & Morman Company, Grand Rapids, Mich.

Electric Variable Speed Drive for Cincinnati Planer

The cut shows a Cincinnati 36-inch forge planer built by the Cincinnati Planer Company, Cincinnati, O., and fitted with a new electric speed controller, consisting of a motor drive arranged so that the operator can change the speed of the cut or return stroke to suit conditions. As shown on the cut the motor is mounted on top of the planer similar to a regular plain motor drive and is coupled direct to the countershaft.



CINCINNATI PLANER WITH VARIABLE-SPEED ELECTRIC DRIVE

The motor is a two to one variable-speed, controlled by the switch board, located at the rear of the housing, on top of which is the usual starting box. On the switch board are two controllers. One is for the cutting stroke by which any desirable cutting speed can be obtained between 25 and 50 feet, without in any way altering the return. The other controller is for the return speed and this can be varied for any return speed between 50 and 100 feet without affecting the speed of the cut.

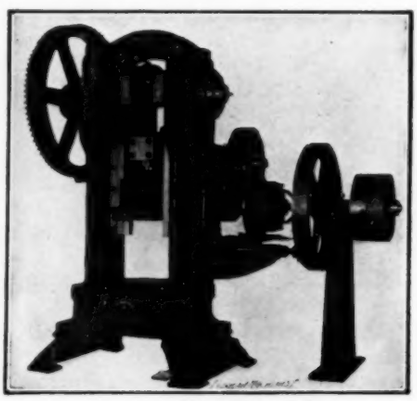
Immediately in front of the housing is a limit switch that operates these controlling levers so that after they have been set for any particular speed, they will automatically return to that speed at each stroke.

The wiring shown is only temporary, as this arrangement does not need any more wiring than a regular drive, except that the wires have to be run to the limit switch.

Press with Friction Clutch

The accompanying halftone shows a straight-sided press made by the Niagara Machine and Tool Works, Buffalo, N. Y. The motion of this machine is controlled by an automatic friction clutch which is thrown in by positive mechanism, consisting of a series of links and levers, which causes the clutch to be fully engaged before the press starts.

The clutch can be tripped by the foot treadle, in which case the motion will stop at the highest point of the stroke after making a complete revolution, or it



PRESS WITH FRICTION CLUTCH

can be operated by hand lever. The power mechanism is disengaged by simply moving the upper end of the operating rod out of line with the upper cam slide. When hand-operated the motion of the slide can be stopped or started at any point of the down or up stroke.

The machine shown weighs about 30,000 pounds. Distance between uprights 28 inches, ratio of gearing 25:1.

Inside Micrometer Caliper

The Plant inside micrometer caliper shown herewith consists of a set of two tools as in Fig. 1, each tool having two screws for different ranges of measurement. The smaller tool with its two screws has a range from ½ to 1 inch, and the larger tool measures from 1 to 2 inches. The micrometer is graduated to give measurements directly in thousandths of an inch and by estimation the operator can obtain measurements to ½ and ¼ thousandths. As illustrated, it offers facilities for measuring accurately throughout the entire depth of the hole.

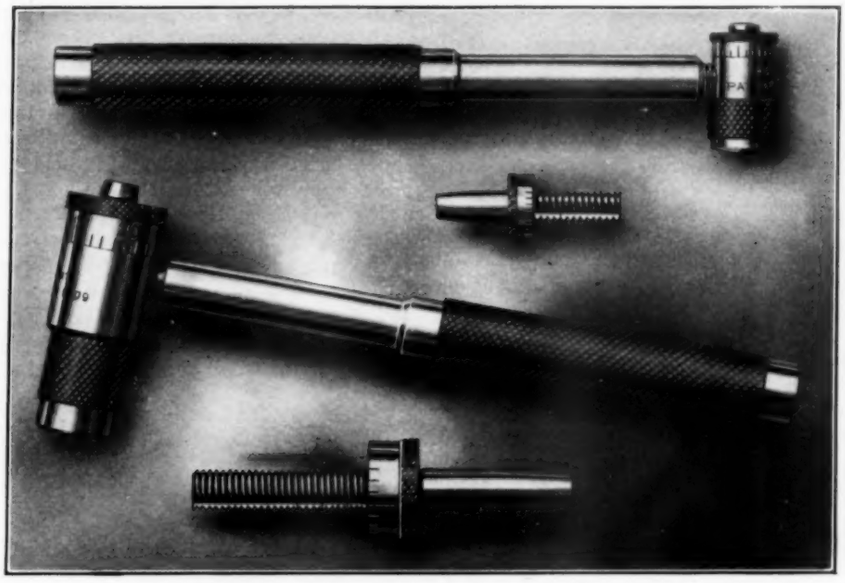


FIG. 1. THE PLANT INSIDE MICROMETER

As shown in Fig. 2, the barrel or body *A* of the instrument holds the measuring screw *B* which is advanced by means of the graduated nut *H*. The screw is prevented from rotating when advanced, by a swivel pin *E* which is held in the end of the handle and which enters a V-slot in the measuring screw. The V-pin is brought to bear upon the screw by slight rotation of the handle *F* which is threaded into the barrel and in this manner the pin is made to lock the measuring screw after the adjustment has been made. Every revolution of the graduated nut advances the screw 25 thousandths and after every fourth revolution the tenth of an inch graduation appears on the face of the slot in the measuring screw just above the upper edge of the nut. To the lower end of the barrel is fitted a nurled cap *C* capable of slight adjustment to compensate for wear.

The parts of this micrometer are hardened throughout with the exception of the measuring screw. It is manufactured by the Emerson Apparatus Company 251 Causway street, Boston, Mass.

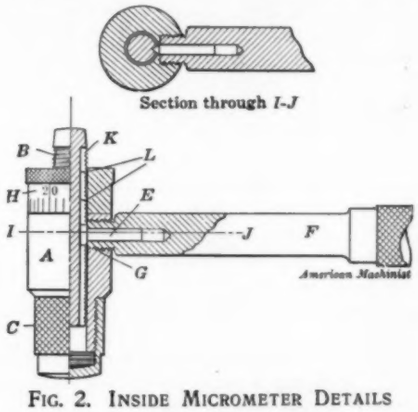


FIG. 2. INSIDE MICROMETER DETAILS

A 15-inch Engine Lathe

Fig. 1 shows a heavy 15-inch standard engine lathe, built by Greaves, Klusman & Co., Cincinnati, Ohio.

The bed of this lathe is exceptionally wide, deep and heavy.

The apron is of the double-plate type with bearings at each end of the studs. All gears are of steel. Cross and long feeds are engaged by frictions. Feed rod and lead screw cannot be engaged simultaneously. Five geared feeds are obtainable from 10 to 160. The feed rod has automatic stop in either direction. Fig. 2 shows the construction of the patent tailstock. This construction admits of a spindle longer than usual, which telescopes through a thimble at the rear, with a full length bearing in the barrel at the forward limit of its travel. It is gripped by double plug clamps at both ends of barrel. This double clamping device is operated by a single handle.

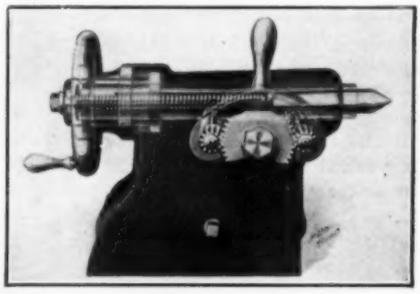


FIG. 2. REAR VIEW OF TAILSTOCK

Two New Monkey Wrenches

The Bemis & Call Hardware and Tool Company, Springfield, Mass., is now placing on the market a steel handle monkey wrench and also one with a wooden handle. These wrenches are made in seven sizes from 6 to 21 inches inclusive.

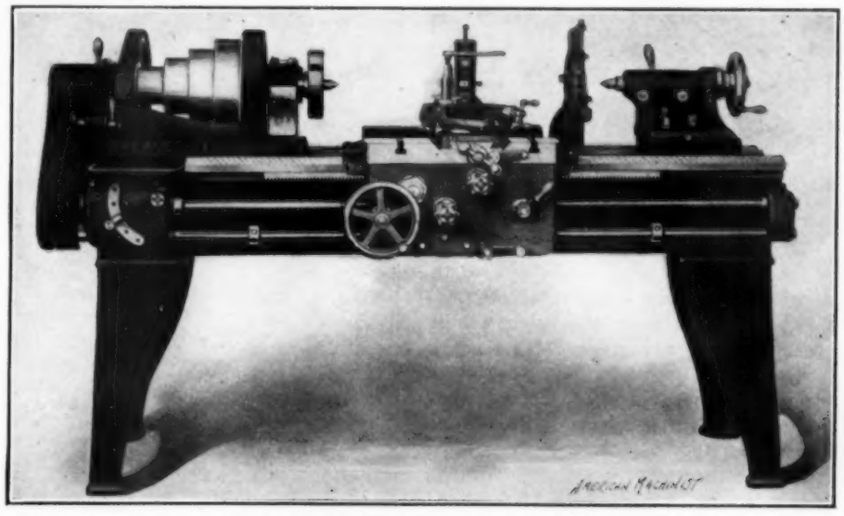
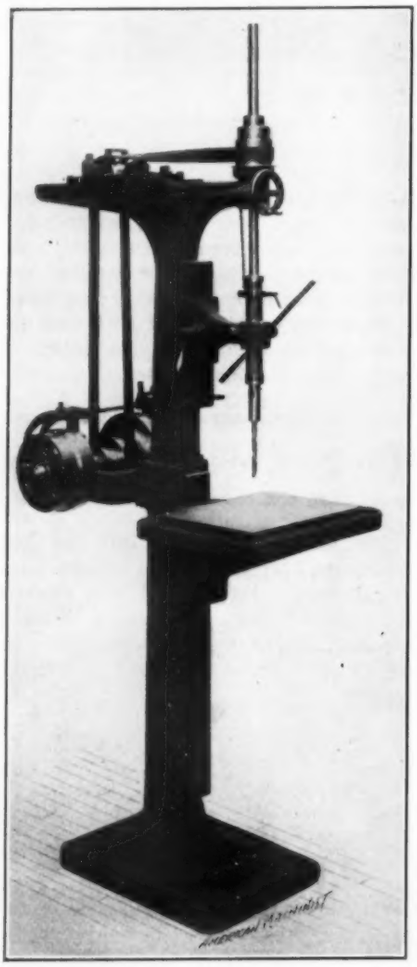


FIG. 1. HEAVY STANDARD ENGINE LATHE

The Avey Sensitive Drill Press

The halftone shows a new ball-bearing drill press, which has been brought out by the Cincinnati Pulley Machinery Company, Cincinnati, Ohio. It is designed to handle drills up to 37/64 inch diameter. The machine is ball bearing throughout, permitting it to be run at highest speeds that high-speed twist drills will stand. Four changes of speed are obtained from a four-step cone pulley on the countershaft, driving to a single pulley on the spindle. The adjustment of the belt when changing speeds, is taken care of by means of a carriage on the back yoke, in which are mounted two idlers. The movement of this idler carriage by means of a screw feed, is controlled by a hand



THE SENSITIVE AVEY DRILL PRESS

wheel immediately in front of the machine at a point most convenient to the operator. The advantage of this screw feed of carriage, in addition to the quick and convenient adjustment, is the positive and precise belt tension it affords. When changing from one size of twist drill to another requiring a slight change in belt tension, a slight turn of the hand wheel gives the exact belt tension required. The depth stop is mounted on the spindle sleeve, which is graduated. The machine is also built with multiple spindles.

A 16-inc Geared Head Lathe

Fig.1 shows a 16-inch geared head lathe, built by Fay & Scott, Dexter, Maine. The lathe is fitted as a plain turning lathe

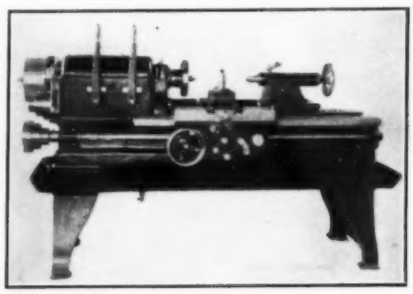


FIG. 1. FAY & SCOTT 16-INCH GEARED LATHE

without lead screw, and is designed to be belted direct from the line shaft, but lead crew and compound rest can be fitted.

Fig. 2 shows the gearing in the head.

Power is transmitted through a single driving pulley, located on the back and drives the spindle through gearing, thus relieving the spindle of all belt pull.

The headstock has four mechanical speed changes, obtained by means of friction clutches. These frictions are of the expanding type, with cork inserts. Changes of speed are accompanied by means of the two levers located at the front of the head, and are made without any shock to the gears while the machine is in motion. The engaging of two conflicting ratios of gearing at the same time,

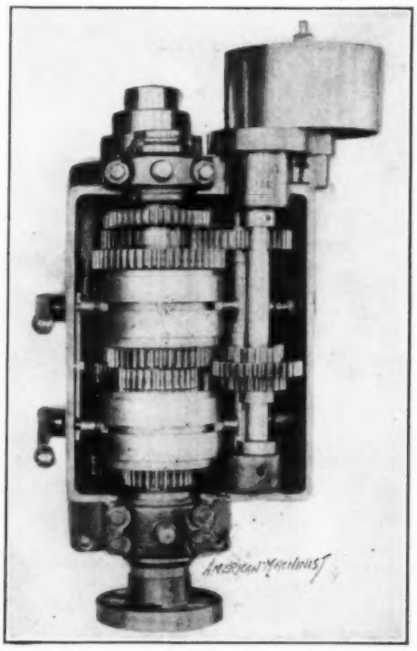
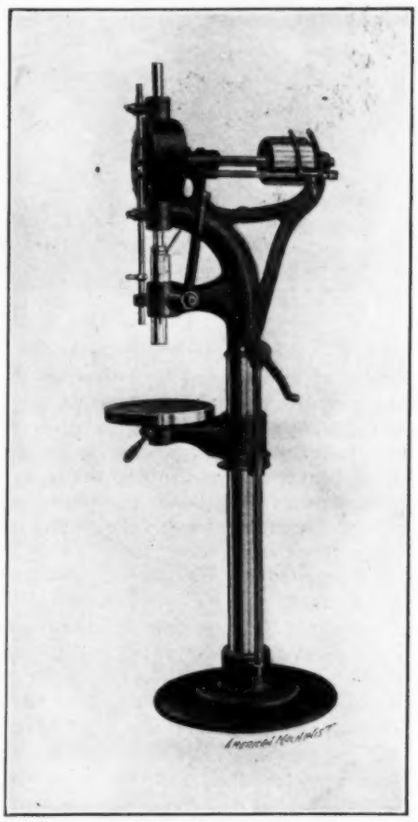


FIG. 2. HEAD SHOWING GEARING

is made impossible. The entire mechanism runs in a bath of oil. The working parts are readily accessible, the friction clutches having a single adjustment by means of a screw driver.

A Geared 16-inch Drilling and Tapping Machine

The halftone shows a machine for drilling and tapping, which is being placed on the market by the Frontier Iron Works, Buffalo, N. Y. On the pulley or driving shaft within the circular case shown on the head is mounted a disk 8½ inches diameter, in which are three concentric rows of hardened steel teeth. On the spindle are mounted two pinions with a clutch between; the pinions are held in position by yokes connected to a tube shown on the outside of the case, the clutch engaging with the pinion. Forward or reverse motions are operated by the



A GEARED 16-INCH DRILLING AND TAPPING MACHINE

handle shown on the vertical shaft. Three changes of speed can be had by moving the upper pinion and clutch together, which can be done while the machine is in motion.

This machine will tap up to ⅝ inch and will drill up to ¾ inch. The column is 4 inches diameter, hight of drill 78 inches, traverse of spindle 4½ inches, greatest distance between spindle and table 36 inches, spindle diameter through sleeve 1⅛-inch hole to conform to Morse No. 2 taper.

There are Scales and Scales

By W. B. Carmack

Some years ago, when I was connected with one of the large small-tool concerns of New England, there appeared one morning a large raw-boned Irishman looking for work and armed with some excellent letters of recommendation. He asked for the boss and was told to wait. The boss came along shortly and the following dialogue ensued:

"What can I do for you, Sir?"

"I want worruck, sorr."

"Where did you work last?"

"At the rope worrucks, sorr."

"Are you familiar with a scale?"

"Yis sorr."

"Let me see" (exhibiting a 12-inch scale and putting his thumb about four inches from the end), "how much is that?"

"About half a *fut*, sorr."

(Putting his thumb about half an inch from the end) "How much is that?"

"A wee bit, sorr."

"Did you ever see a scale before?"

"Oh yis, sorr."

"Where?"

"At the rope worrucks, sorr."

"Did you use it?"

"Yis sorr, Oi did, to weigh the rope, sorr."

The applicant got a job and made a first-class man.

Moral: You cannot always judge a man by his appearance or answer.

Increasing Shop Capacities

Metal Working

NEW ENGLAND

The Clinton (Mass.) Wire Company will build a $300,000 addition.

The Athol (Mass.) Machine Company is building an addition to its plant.

Fire destroyed the repair shop of the Boston & Albany Railroad, at North Dana, Mass.

The Metal Products Corporation, Providence, R. I., has purchased site for a plant.

The American Fork and Hoe Company, St. Johnsbury, Vt., will erect additions to its plant.

The F. E. Wells & Son Company, Greenfield, Mass., is building a machine-shop addition and forge shop.

The Taplin Manufacturing Company, New Britain, Conn., making hardware specialties, is planning to build a two-story addition.

The Clark & Coombs Company, manufacturing jewelry, Providence, R. I., will remove its plant to the new Wall building.

The Holland Torpedo Boat Company, Quincy, Mass., will remove its plant to New London, Conn., and will build gas engines, air compressors, etc., in addition to torpedo boats.

The Highwood Company, New Haven, Conn., has been incorporated to manufacture tools and machinery. Capital, $50,000. Incorporators, Jas. E. Wheeler, Jacob Caplan, Edward T. Stanford.

The Phœnix Machine Company, Fairhaven, Mass., has been incorporated to manufacture machinery, mill specialties, etc. Capital, $50,000. Orin A. Pearce, 48 Foster street, New Bedford, president.

MIDDLE STATES

The Moline (Ill.) Foundry Association is seeking a new location.

The Electric Cleaner Company, Chicago, Ill., is seeking suitable site for a plant.

The Doylestown (Ohio) Aluminum Company will probably locate in Wooster, Ohio.

J. F. Wright, Canton, Ohio, is endeavoring to secure site on which to erect a pipe-wrench plant.

The Gisholt Machine Company, Madison, Wis., will make extensive additions to its plant.

The Gendron Wheel Company, Toledo, Ohio, will erect a five-story addition to its plant.

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

Cochran Bros., Washington, N. J., will build a new factory for the manufacture of hardware specialties.

Contract has been awarded for erecting a new foundry for F. E. Myers & Co., Ashland, Ohio, to cost about $40,000.

Fire badly damaged the brass works of Martin Reynolds Sons, 68-70 Richardson street, Brooklyn, N. Y.

The Judd & Leland Manufacturing Company, Clifton Springs, N. Y., manufacturing tinware, will build a three-story addition.

It is reported that the Abbott Motor Company, Warren ,Ohio, is considering the erection of a new plant in the Central West.

Work has been started on a new plant for the Marion (Ohio) Shovel and Dredge Company. Four large shop buildings will be erected.

A large addition is to be erected to the plant of the Gary Iron and Steel Company, at Niles, Ohio. The cost of the improvement will be $200,000.

The Christmas Aëroplane Company, Inc., Washington, D. C., has been incorporated with $200,000 by Wm. Whitney Christmas, Calvert Hines, Robert Ions.

The Mattoon Machine and Foundry Company, Mattoon, Ill., has been incorporated by Chas. N. Coon, John Cantlon, Sr. and Oscar C. Miller. Capital, $25,000.

The plant of the Raymond Manufacturing Company, Corry, Penn., was destroyed by fire. Loss, $25,000. The company manufactured wire springs and wire specialties.

Fire gutted the old and new machine shops, engine and boiler rooms at the repair plant of the Southern Railway in Princeton, Ind., causing a loss of $200,000. Will be rebuilt.

The Rockford Tool Company, Rockford, Ill., has been incorporated to manufacture machinery. Capital, $50,000. Incorporators, Levin Faust, Swan F. Anderson, Hugo L. Olson.

The Barnes Automobile Fender Company, Asbury Park, N. J., has been incorporated with $250,000 by Wm. D. B. Barnes, W. H. Bechtel, etc. Will manufacture automobile fenders.

Plans are being prepared for a large garage and repair shop for Oscar Lear, on East Long street, Columbus, Ohio. The plant will be one of the most complete of its kind in the State.

The Wells-Boughton Company, Troy, N. Y., has been incorporated to manufacture bridges and structural work. Capital, $15,000. Incorporators, Earle H. Wells, Chas. D. Boughton, M. Boughton.

The Cross-Magill Motor Truck Company, New York, has been incorporated to manufacture motors, motor vehicles, etc. Capital, $100,000. Incorporators, C. J. Cross, W. F. Magill, P. S. Tilden.

The General Manufacturing and Machine Company, Appleton, Wis., has been incorporated with $25,000 capital by B. P. Pollock, Geo. L. Hart, W. H. Scheel. Will manufacture a hotel cooking range.

The Premier Machine Company, Princeton, N. J., has been incorporated to manufacture machinery, mechanical devices, etc. Capital, $100,000. Incorporators, Chester Huntington, J. Francis Sullivan, Edward Frohling.

The Harris Auto Company, Atlantic City, N. J., has been incorporated. Capital, $60,000. Incorporators, Wm. B. Loudenslager, Jas. B. McDevitt, F. C. Muller. Will manufacture motors, engines, machinery, etc.

German-American Ball Bearing Manufacturing Company, Chicago, Ill., has been incorporated to manufacture machinery and tools. Capital, $100,000. Incorporators, Richard A. Schultz, L. Gaines, C. F. Schultz.

The Electro Steel Company, Hoboken, N. J., has been incorporated with $55,000 capital to manufacture iron, steel, metal materials, etc. Incorporators, Gustave Vintschger, C. W. A. Hammacher, Edward Vintschger.

The Elgin Wheel and Engine Company, Elgin, Ill., has been incorporated with $30,000 capital to manufacture a baby-carriage wheel and a toy engine invented by Herbert L. Thompson and Nelson W. Johnson, of Elgin.

The Crawford Manufacturing Company, Robinson, Ill., has been incorporated to manufacture machines and novelties of wood.

iron and metal. Capital, $50,000. Incorporators, O. L. Huffman, S. P. Headley, C. C. Cartwright.

Manufacturies Equipment Company, Dayton, Ohio, has been incorporated to manufacture and sell machinery. Incorporators, G. H. Mattern, John L. Schroll, W. H. Sachs, E. M. Mahlmeister and I. M. Justice. Capital, $25,000.

Pillrod Bros. Company, Toledo, Ohio, has been incorporated to manufacture and sell locomotive appliances and all kinds of mechanical devices. Incorporators, Henry J. Pilliod, Charles J. Pilliod, Julian H. Tyler, etc. Capital, $100,000.

The Hammer Drill Company, 475 Bloomfield avenue, N. J., has been incorporated to manufacture mining, quarrying and stone-working machinery. Capital, $125,000. Incorporators, Henry M. Quale, Robert K. Seveille, Harry J. Christensen.

The Wilson Motor Car Company, Newark, N. J., has incorporated to manufacture motors, engines, machinery, etc. Capital, $50,000. Incorporators, S. P. Wilson, John Foley, Jr., 476 Clinton avenue, Newark; G. A. Lutz, 17 Danforth avenue, Jersey City.

Militarie Auto Company, Cleveland, Ohio, has been incorporated to manufacture and sell automobiles, motorcycles and accessories. Capital, $300,000. Incorporators, M. L. Thompson, Vernon E. Davis, Walter S. Sapp, R. M. Roderick, George A. Gaston.

The Montgomery County Auto Company, Dayton, Ohio, has been incorporated to deal in automobiles and operate a repair shop. Incorporators, Howard G. Wiley, Sylvester A. Long, A. M. Klepinger, Charles E. Foreman, P. M. Klepinger. Capital, $15,000.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids November 1, for two radial drills (schedule 2994), one lathe (schedule 2993); November 15, two flat turret lathes (schedule 2992), 50 pneumatic hammers (schedule 3011).

Fiber Products Sales Company, Cleveland, Ohio, has been incorporated to manufacture and sell automobile supplies, equipment and specialties. Incorporators, Roy J. Jeffries, Agnes Granthey, A. S. Dale, Florence C. Jeffries and J. P. Bibean. Capital, $15,000.

Anchor Buggy Company, Cincinnati, Ohio, has been incorporated to manufacture and sell vehicles of every description, including motor cars. Incorporators, Anthony G. Brunsman, Alfred F. Klausmeyer, Earle M. Galbraith, W. J. Brunsman and O. E. Schroth. Capital, $400,000.

SOUTHERN STATES

The A. D. Howe Machine Company, Wheeling, W. Va., will erect a garage at 2156 Main street.

The Berwind-White Coal Mining Company will erect shops at Newport News, Va., for repairing coal cars.

The Baldwin Steel and Forging Company has commenced the construction of a new plant at Parkersburg, W. Va.

Ideal Motor Car Company, Hopkinsville, Ky., recently formed, has awarded contract for the erection of a garage. Chas. S. Jackson is president.

WEST OF THE MISSISSIPPI

Ekern Bros., of Flandreau, S. D., will erect a blacksmith shop.

Arthur Loveland, of Long Pine, Neb., will erect a machine shop.

The United Iron Works, Oakland, Cal., is erecting a four-story addition.

Jas. Cramer's blacksmith shop at Faulkton, S. D., was burned. Will rebuild.

The Fulton Iron Works, St. Louis, Mo., will erect a new shop building to cost $14,000.

The Union Pacific Railroad, at Omaha, Neb., will build a $160,000 shop; also sawmill, etc.

The Gogebic Steam Boiler Works will build a $20,000 addition on Lake street, Duluth, Minn.

Shatto & Son are preparing to erect a modern blacksmith and machine shop at Lorimor, Iowa.

J. F. Knowlton, of Canton, S. D., has commenced the erection of a gasolene-engine factory.

The plant of the American Metal Company, La Harpe, Kas., was damaged by fire. Loss, $10,000.

George Diehm, Central avenue, Los Angeles, Cal., will erect a garage and repair shop 37x75 feet.

J. D. Hooker, of Los Angeles, Cal., will erect a three-story garage and repair shop at Twelfth and Flower streets.

A. T. Hawley, San Diego, Cal., will erect a garage on University street. Modern repair machinery will be installed.

A garage and repair shop will be erected at Camarillo, near Oxnard, Cal., by W. P. Daly. Modern repair machinery will be installed.

The Maxwell-Briscoe Company will erect a three-story and basement garage and repair shop on Olive and Twelfth streets, Los Angeles, Cal.

A two-story garage and repair shop will be erected by Jas. J. Freeman on South Grand avenue, Los Angeles, Cal. Modern equipment will be installed.

Improvements to cost $2,000,000 will be made at the plant of the Western Steel Corporation, at Irondale, Wash. Four big steel rolling mills will be added.

The Bartley Manufacturing Company has been incorporated at Portland, Ore., to manufacture stoves, ranges and foundry products. Capital, $15,000. Incorporators, A. P. Bartley, F. J. R. Dawson, Chas. Cockefair.

CANADA

The Canadian Billings Spencer Company, of Welland, is doubling its plant.

The Joliette Steel and Iron Foundry will build a large plant at Joliette, Quebec.

Kemp & Craise are building a large garage and automobile-repair shops at Petrolia, Ont.

The Myers Fence and Iron Company will locate a large branch factory at Regina, Sask.

The W. J. Duncan Foundry, at Campbellton, New Brunswick, is being largely extended.

The Percival Plough and Stove Company is building a large new factory at Merrickville, Ont.

A syndicate headed by W. Owen, of Vancouver, has secured a site for a very large steel plant and iron foundry there.

The Canada Cycle and Motor Company has taken out a permit for a four-story factory to be erected on Weston road, near St. Clair, Toronto, Ont.

GENERAL MANUFACTURING

NEW ENGLAND

Merrows Bros., Auburn, Me., propose to erect a packing plant.

The National Flooring Company, St. Johnsbury, Vt., will erect an addition.

The Warwick Lace Works, Riverpoint, R. I., will erect an addition to its plant.

The Shambow Shuttle Company, Woonsocket, R. I., will erect a new plant.

The Cabot Manufacturing Company will build a paper mill at Brunswick, Me.

The plant of the Swift River Box Company, North Dana, Mass., was destroyed by fire.

H. G. Shepard & Sons, New Haven, Conn., are building a new engine and boiler room.

The plant of the Chester (Vt.) Bobbin and Spool Shuttle Company was burned. Loss, $10,000.

The plant of the Frost Chemical Company, West Barrington, R. I., was destroyed by fire. Loss, $25,000.

The Forestdale Worsted Mills and the Fabyan Woolen Mills, at Stafford Springs, Conn., were destroyed by fire.

The Puritan Comb Company, Leominster, Mass., has been incorporated to manufacture combs and hair ornaments. Capital, $10,000. Walter F. Hicks, of Worcester, is president.

The Specialty Manufacturing Company, 223 Essex street, Melrose, Mass., is considering the establishment of a plant in the South for the manufacture of chair beds and couch beds.

The Norwich, Colchester & Hartford Traction Company has purchased the plant of the Colchester Rubber Company, near Norwich, Conn., and will use same for power plant and car barns.

MIDDLE STATES

The J. W. Wells Company will erect a new sawmill at Menominee, Mich.

The barrel works of G. B. Struble, Harrison, N. J., was destroyed by fire.

The Manning Paper Company, Troy, N. Y., is looking for site for a new plant.

The J. L. Metz Furniture Company, Chicago, Ill., will erect a new factory.

The National Rubberette Company will establish a branch factory at Davenport, Iowa.

The plant of the Falconer (N. Y.) Light and Power Company was destroyed by fire.

A. A. Geitgey, of Danville, Ohio, is looking for a suitable site on which to locate a hoop mill.

Plant No. 1 of the Belair (Md.) Electric Company was destroyed by fire. Will be rebuilt.

The Davenport (Iowa) Locomotive Company will erect a carpenter shop to cost $15,000.

The Brooks & Ross Lumber Company will build a new mill at Schofield, a suburb of Wausau, Wis.

The Western Reserve Condensed Milk Company, Cleveland, Ohio, is looking for site for another plant.

R. Alden & Sons, of Ladysmith, Wis., will establish a wood-turning and enameling plant at Bruce, Wis.

The American Fork and Hoe Company, Ashtabula, Ohio, will erect a larger power house at its plant.

The Columbus (Ohio) Railway Company will erect a three-story boiler house at 14 North High street.

The James City (Penn.) plant of the American Plate Glass Company, was destroyed by fire. Loss, $75,000.

The plant of the Johnson Creek Lumber Company, of Knowlton, Wis., was destroyed by fire. Loss, $5000.

The United States Sugar Refining Company, Madison, Wis., is planning to enlarge its plant at Fair Oaks.

The Novelty Dye Works was destroyed by fire at Jefferson and Michigan street, Milwaukee, Wis. Loss, $25,000.

The Toledo (Ohio) Railway and Light Company is preparing to erect a new substation at 408 Front street.

The Shanahan Ice Cream Company, 780-82 South Swanson street, Philadelphia, Penn., will install an ice plant shortly.

The F. N. Burt Company will erect a $25,000 addition to its paper-box factory at 551 Myrtle avenue, Buffalo, N. Y.

The Quaint Art Furniture Company, 896 Cortland avenue, Syracuse, N. Y., is said to be considering the removal of its plant.

The Empire Steel and Iron Company, Oxford, N. J., will increase the capacity of its power plant. Will install new boiler, etc.

The Chittenden-Eastman Furniture Company, of Burlington, Iowa, will establish a mattress and furniture factory, at Kansas City, Mo.

The J. W. Storandt Manufacturing Company, Rochester, N. Y., making interior fixtures, show cases, etc., has purchased site for a new plant.

The mills, dock and warehouse of the United States Gypsum Company, at Alabaster, Mich., were destroyed by fire. Loss, $400,000. Plant will be rebuilt.

George J. Meyer has purchased factory site of the Frontier Iron Works, on Auburn avenue, Buffalo, N. Y., and contemplates the erection of a malthouse.

The Business Men's Association, of Cohoes, N. Y., is negotiating with a New York concern, which is looking for a site for a plant to manufacture paper novelties.

Additions to the Bavarian Brewing Company, of Toledo, Ohio, will soon be begun. One of the buildings will be a bottling plant and a five-story storage building will also be built.

The State Board of Control, Madison, Wis., will buy one 700-gallon high-lift turbine pump and one 100-horsepower steam engine. Address M. J. Tappins, secretary, state board of control, Madison, Wis.

Fire in Syracuse, N. Y., damaged machinery of the Syracuse Shirt Manufacturing Company, Gaylord Brothers, manufacturing office and bank supplies, the Exstein Suspended and Overall Company, and the June Press.

The Leader Manufacturing Company, Cleveland, O., has been incorporated to manufacture and sell all kinds of rubber articles and novelties and to make vulcanizers. Incorporators, J. R. Baird, A. M. Tonsley, Charles S. Beardsley, etc. Capital, $15,000.

Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until 11 a.m., December 3, for coal and ash-handling apparatus for the central power station at the Norfolk Navy Yard. Information can be had of R. C. Holllyday, chief of bureau.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids November 1, for 35 steam ftraps (schedule 3003), 6700 pounds steel bolts and nuts, 5300 pounds steel boiler rivets (schedule 3004), 2500 pounds steel bolts and nuts (schedule 3009), twist drills, reamers, files (schedule 2996), 12,700 pounds phosphor bronze (schedule 2997), 27,000 pounds forged or hot-rolled steel (schedule 3007), 32,300 pounds machine steel (schedule 3004).

SOUTHERN STATES

The plant of the Adeline (La.) Sugar Refining Company was burned. Loss, $400,000.

The city of Smithfield, N. C., will construct an electric-light plant. James A. Wellons, mayor.

The Berkley (Va.) Box and Lumber Company will erect a plant. Will install box and planing machinery.

The city of Portsmouth, Va., will vote on issuance of $400,000 bonds for waterworks. J. Davis Reed, mayor.

The city council, Fort Meade, Fla., has granted a franchise to S. T. Rivers, for an electric-light and power plant.

The city of Sanford, Fla., will, it is reported, install additional machinery in its electric-light plant to cost $20,000.

The Foster Falls Company, Foster Falls, Va., has been incorporated with $100,000 to build a water-power electrical plant.

The Nashville (Tenn.) Spoke and Handle Manufacturing Company is making investigation with a view of securing site for a new plant.

The Birmingham (Ala.) Soap Manufacturing Company will erect a plant in Avondale, Ala. Offices are in the Brown-Marx building, Birmingham.

The Atlantic Ice and Coal Corporation, Atlanta, Ga., has appropriated $150,000 to build additional ice and storage plants in Atlanta, and $200,000 for additions to plants in Georgia, Tennessee and Florida.

WEST OF THE MISSISSIPPI

J. S. Armstrong, of Ontario, Cal., will erect a packing house.

The Duluth Box Factory, at West Duluth, Minn., was burned.

Philip Essling, of Lafayette, Minn., will erect a feed mill this fall.

John Mans, of Cohasset, Minn., has secured site for the erection of a sawmill.

The Anaheim Sugar Company, Anaheim, Cal., is building a sugar factory.

The city of Long Beach, Cal., will install a modern sewage pumping plant.

A 3,000,000-gallon pump will be added to the water plant at Junction City, Kan.

Installation of a municipal electric-light plant is being agitated at Wymore, Neb.

The California Vegetable Union, Placentia, Cal., contemplate the erection of a plant.

The Garthy & Jennings single mill, at Kettle Falls, Wash., was destroyed by fire.

J. S. Peterson, of Kenmare, N. D., will establish a rope factory at Stanley, N. D.

The Raab Creamery Company, South Pasadena, Cal., is building an addition to its plant.

The Laughlin Secret Call Telephone Company will build a new shop at Clay Center, Kan.

Lawrence Burck, Los Angeles, Cal., will install a sewer system in his Cottage Home tract.

The Edwin C. Smith Flour Mill, at Des Moines, Iowa, was destroyed by fire. Loss, $50,000.

Hanson & Sears, of Ontario, Cal., are remodeling and adding an addition to their packing house.

The Golden State Canning Company, Ontario, Cal., will erect a storage building on East Main street.

The Des Moines Saw Mill Company will erect a mill at Ninth and Market streets, Des Moines, Iowa.

The city of Whittier, Cal., will build a new city hall. Modern apparatus will be installed throughout.

The Santa Barbara Gas and Electric Company, Santa Barbara, Cal., will erect a new machinery building.

The American Sewer Pipe Works, Brazil, Ind., has commenced the construction of a new $125,000 plant.

The Southern Pacific Company is erecting a new subsidiary power plant in the West Oakland (Cal.) yards.

The warehouse of the Cope Commercial Company, of Redlands, Cal., was destroyed by fire. Loss, $9000.

The Cobb Vegetable Company has leased property at Placentia, Cal., and contemplate the erection of a plant .

A sewer system will be installed at Yuma, Arizona, to cost $45,000. Bonds have been voted upon to this sum.

J. J. Sommans, 19 South Chester avenue, Pasadena, Cal., will erect a cut-glass factory to cost about $5000.

The grain mill of A. Leslie & Son, Portersville, Cal., was destroyed by fire. Loss, $14,000. It will be rebuilt.

The Los Angeles Paper Manufacturing Company, Los Angeles, Cal., has completed a new building on Manitou avenue.

The Northern Insulation Company will erect a factory building at Wabash and Raymond avenue, St. Paul, Minn.

The Alliance Creamery Company, of Alliance, Neb., will erect an addition as refrigerating and cold-storage plant.

The City Lumber and Wrecking Company, San Diego, Cal., has taken out a permit for the erection of a planing mill.

Pohlman Brothers, of Portersville, Cal., will erect a grain storage warehouse. Modern equipment will be required.

Steam-heating equipment will be required in the new apartment house to be erected in San Diego, Cal., by J. C. Rice.

The Wares Grain Binder Attachment Company will erect a factory at Pelham and Franklin streets, St. Paul, Minn.

The Arlington Coöperative Creamery Company, recently incorporated, will erect a modern creamery plant at Arlington, Cal.

A cold-storage plant will be required on the incubator and chicken farm of Lewis and Raymond Whipple, near Ontario, Cal.

The Placentia Warehouse Company, of Placentia, Cal., on the Santa Fe line, will erect a packing house to cost $13,000.

Steam-heating equipment, etc., will be required in the new hotel to be erected at Merced, Cal., by the Merced Investment Company.

A heating plant will be required in the city hall at Santa Ana, Cal.; bids and specifications will be advertised for in the near future.

The Yucaipa Water Company, of Redlands, Cal., has secured a bond issue for $150,000, which will be used in improving its water system.

The Pasadena Orange Growers 'Association, Pasadena, Cal., will erect a packing house to cost $10,000. Modern machinery will be installed.

The city trustees of Calexico, Cal., have called an election for a vote on a bond issue of $35,000 for a new sewer system for the city.

Emil Firth, Los Angeles, Cal., will install a complete irrigation system in connection with a modern pumping plant in his Orange Cove tract.

The Iowa Gas Company, of Iowa Falls, Iowa, has sold its plant to F. N. Letton and C. M. Butterworth, who mill enlarge and improve same.

Power-plant equipment and refrigerating machinery will be required in the new building being erected by F. & W. Thum Company, Pasadena, Cal.

Pumping machinery and irrigation apparatus will be required by T. C. Van Dyke on his 37,000-acre ranch, "San Ysidro," near San Diego, Cal.

Alterations and additions are planned for the Hotel Virginia, Long Beach, Cal. Electrical apparatus, machinery equipment and laundry materials will be required.

The Golden State Portland Cement Com-

pany will erect a plant at Oro Grande, near San Bernardino, Cal. The contract for the buildings has been let and work will begin in a month.

The Consolidated Reservoir and Power Company, of Banning, Cal., has begun operations in the San Bernardino mountains, north of Banning, on its irrigation and electric power plant.

A water and sewer system will be installed at new Tia Juana, near the international boundary, Mexico. Chas. L. Gaskill, San Diego, Cal., is in charge of all improvements to be made at this place.

The Western Manufacturing and Building Company, Aberdeen, S. D., has been incorporated with $100,000 capital and will erect a plant for the manufacture of sash, doors, moldings, etc. L. L. Cummings is president.

CANADA

John R. Molson, of Montreal, is building a large new brewery.

The Lawrie Wagon Company, of Winnipeg, is extending its plant.

The Diamond Glass Company, of Hamilton, Ont., is doubling its plant.

The Imperal Electric Company will locate a factory at Windsor, Ont.

The Canadian Sand Blast Company will build a factory at Montreal.

Philip Pocock, of London, will build a large rubber factory at Merritton, Ont.

The George Hachorn Furniture Company, of Berlin, Ont., will double its plant.

The Selkirk Match Company will equip a $40,000 factory at Neepawa, Manitoba.

The Foley Reiger Pulp and Paper Company will locate a large plant at Thorold, Ont.

The Dominion Linseed Oil Company will equip a large plant at Regina, Saskatchewan.

E. H. Mann's cheesebox factory, destroyed by fire at Peterboro, Ont., will be rebuilt at once.

Prince Albert, Saskatchewan, will buy $7000 worth of new boilers for its power house.

The Harquail Woodworking Company will build a large new factory at Campbellton, New Brunswick.

Prince Albert, Saskatchewan, will spend $12,000 for filtration machinery, and $2500 for waterworks supplies.

Fire destroyed $35,000 worth of machinery in A. S. Fillmore's carriage factory, at Athol, Nova Scotia. Will be replaced at once.

The Canadian Fisheries and Cold Storage Company will spend a million dollars equipping a plant and docks at Prince Rupert.

Robert Simpson & Co. will build a two-story additon to their wagon shop on Dalhousie street, near Wilton, Toronto, Ont.

The largest cement plant in the world will be located on the Chilliwack river, near New Westminster, B. C. C. D. McRae, engineer.

Business Items

The E. W. Bliss Company, Brooklyn, N. Y., has been awarded the Grand Prize for its machines at the Brussels Exposition.

The Gisholt Machine Company and Joseph T. Ryerson & Son announce an association of interests in the manufacture and sale of machine tools. Coincident with the new relationship, Edward L. Ryerson and Clyde M. Carr, of Joseph T. Ryerson & Son, become directors of the Gisholt Machine Company. The Gisholt Machine Company further announces the construction and equipment of new shops and buildings which will add greatly to its present capacity and which, supplemented by the combined efforts of the sales organizations of the two companies, will permit of best serving its rapidly increasing business. Joseph T. Ryerson & Son, by this announcement, signalize their entrance into the general machine-tool field, in addition to a greater activity in the machinery lines with which they have been identified.

Trade Catalogs

Barber-Colman Company, Rockford, Ill. Circular. Eighteen-inch circular milling machine. Illustrated.

Pike Manufacturing Company, Pike, N. H. Catalog. Pyko grinders. Illustrated, 24 pages, 3½x6 inches.

Bemis & Call Hardware and Tool Company, Springfield, Mass. Catalog No. 20. Wrenches. Illustrated, 16 pages, 6x9 inches.

Allis-Chalmers Company, Milwaukee, Wis. Booklet. Friction clutch pulleys and clutch couplings. Illustrated, 8 pages, 3x6½ inches.

Triumph Electric Company, Cincinnati, Ohio. Bulletin No. 391. Direct-current steel-frame motors. Illustrated, 16 pages, 6x9 inches.

Chas. H. Field, Providence, R. I. Circulars. Combination molds and ladles for casting soft-metal hammers and vise jaws. Grinding and polishing machine. Illustrated.

Forthcoming Meetings

International aviation meet, Belmont Park, Long Island, October 22 to 30. Auspices of the Aëro Club of America, 29 West Thirty-ninth street, New York City.

National Machine Tool Builders' Association, annual meeting, October 25-26, Hotel Astor, New York. Chas. E. Hildreth, secretary, Worcester, Mass.

National Society for Promotion of Industrial Education, fourth annual convention, Boston, Mass., November 17, 18 and 19.

American Society of Mechanical Engineers, annual meeting, December 6-9, New York. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

B. Jahn, New Britain, Conn., makes dies, tools, models and specialties.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

The "Gas Saver" brazing forge; circular. J. L. Lucas & Son, 2 Fox St., Bridgeport, Ct.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Wanted—Medium weight specialties or contract work. Wm. A. Cather, Pottsville, Penn.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Let us be your factory; anything in metal; small work a specialty. P. O. Box 284, Anderson, Ind.

Will Mr. Brown Jackson communicate with Ed. Montague, Supt. Holm's Machine Mfg. Co., Sparta, Mich.

If you want special machinery or tools designed, I can give you satisfactory service. Box 39, AMERICAN MACHINIST.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Will purchase interest in going concern and take active management of shop or office. Address "Stephens," AMERICAN MACHINIST.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Machinery and manufacturing plants, designed, constructed, examined and reported on. A. W. Jacobi, Engineer, 192 Market St., Newark, N. J.

A well equipped machine shop, located in New York City, desires contracts for gear cutting or machine work of any kind. Box 97, AMERICAN MACHINIST.

Wanted—Automatic screw machine work, up to and including 9/16-inch diameter, for latest multi-spindle machines; prompt deliveries and reasonable prices. Woburn Gear Works, Nashua St., Woburn, Mass.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Wanted—160,000 lineal feet of square pipe or tubing, 1¼x1¼x1/16 inches thick, to be used for cross-piling strips between lumber; manufacturers will be put into communication with purchaser by addressing "X Y Z," Box 62, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Draftsman used to marine engine and boiler work; state experience and salary expected. Collingwood Shipbuilding Company, Limited, Collingwood, Ontario, Can.

CONNECTICUT

Wanted—First-class layout draftsman, assembly draftsman and detailers. Apply to Harold L. Pope, The Pope Manufacturing Co., West Works, Hartford, Conn.

ILLINOIS

Wanted—Foreman; a thoroughly capable uptodate man for tool room, employing twelve to fifteen men; good salary to a man able to handle others and lay out work; give full

particulars, experience, salary earned, etc. Box 92, AMERICAN MACHINIST.

Wanted—Assembly room superintendent, with broad experience, in a big manufacturing plant; a brainy, active, thoroughly capable man with plenty of executive ability; able to handle big output and make the goods right; good salary to right man; give full particulars, experience, salary earned, etc. Box 91, AMERICAN MACHINIST.

INDIANA

Wanted—Four operators for Gleason bevel gear generators; four operators for Bilgram bevel gear generators; six operators for Brown & Sharpe automatic spur gear cutters; also one man capable of producing results that has had experience in all gear cutting lines, that would be capable of taking charge of large gear cutting department; none but first-class men need apply. 423 Johnson Block, Muncie, Ind.

MASSACHUSETTS

Experienced salesman wanted to travel from Boston to Chicago selling an extensively advertised and popular machine tool; state salary desired and past experience in selling. Box 109, AMERICAN MACHINIST.

MICHIGAN

Wanted—Thoroughly competent machinist to act as working foreman in growing automobile manufacturing concern, chassis assembly; must be able to handle men and keep down cost of production; must understand gasolene engine, toolmaking and be able to work from sketches; not necessary to be an automobile man; we have good opening for an uptodate, competent producer; give reference, age and salary required in first letter; correspondence confidential. Box 101, AM. M.

NEW JERSEY

Wanted—Press room foreman; A-1 man on drawing dies of all kinds; fine opportunity for right man; state experience and salary expected. Box 78, AMERICAN MACHINIST.

By a chemical factory, a competent mechanic, with thorough experience in electrical machines, who speaks English and German languages, as foreman; must be man of practical experience, of good executive ability and high character; a good opportunity will be offered to right party; in replying give reference and experience in detail. Box 94, AMERICAN MACHINIST.

NEW YORK

Grinder hands wanted; good plain wet grinder hands; first-class men please apply. F. I. A. T., Poughkeepsie, N. Y.

Wanted—A working foreman in a small repair shop; must be up to date and have wide experience. Box 113, AMER. MACH.

Wanted—First-class toolmaker, experienced on plumbers' brass work; give experience, reference and salary expected. Box 110, AM. M.

Castings—Salesman by agency of leading foundries; brass and iron; Greater New York; we have established trade; good chance; state experience. Box 114, AMERICAN MACHINIST.

Die sinker-engraver wanted; first-class man to make small embossing dies; good position with good pay to right party; state experience; send samples if you can. Orro Manufacturing Co., 119 West 25th St., New York.

Tool setter and operators wanted for Potter & Johnston semi-automatic machinery; first-class men please apply. F. I. A. T., Poughkeepsie, N. Y.

Wanted—Practical man as superintendent or foreman and invest few thousand; established company, well equipped small factory; too much business present capital; open fullest investigation. Box 108, AMER. MACH.

Foreman Wanted—A well equipped modern shop in vicinity of New York City manufacturing light machinery and instruments in large lots, desires general foreman; must be thoroughly acquainted with modern practice, including automatic and hand screw machines, and able to work with cheap help; to a man occupying such a position and producing results a good proposition is open; will not consider a man out of a position; all replies confidential. Box 116, AM. MACH.

OHIO

Wanted—First-class foreman for automatic screw machines, by a large manufacturing concern, located in the Eastern Central States; must be very competent, familiar with Cleveland, Acme and Gridley automatic machines, on large work; we want to hear from live, capable men, stating salary, experience and references. Box 88, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—A first-class locomotive draftsman; one with experience in designing; state salary expected. Box 75, AMER. MACHINIST.

Wanted—Lathe, boring mill and floor hands for day and night work. Address the Jeanesville Iron Works Company, Hazleton, Penn.

Machinist, first class of wide experience, required as inspector on machine tool work; state age, experience and salary expected. Box 77, AMERICAN MACHINIST.

Wanted—Draftsman capable of laying out work and designing on machine tools; must have shop experience; give references and salary expected. Box 79, AMER. MACHINIST.

Wanted—Instructors in mechanical engineering in an eastern institution; graduates from technical schools, preferably with one or two years' experience. Address with references, Box 115, AMERICAN MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WISCONSIN

General foreman experienced in gas engine manufacture for automobiles; also experienced superintendent for automobile factory; good opportunities for right men starting at nominal salaries; give nationality, age, experience in full and salary expected in first letter. Box 104, AMERICAN MACHINIST.

FOREIGN

Wanted for St. Petersburg, Russia, toolmaker, first class, on high grade machinery; one experienced in making tools, jigs and fixtures for Cleveland automatic and Warner & Swasey turret machines; must also understand hardening; one who speaks German or Russian language preferred; works enlarging, may become superintendent if capable of handling men. Write full details, giving experience, references and salary expected. Pneumatic Tool Co., St. Petersburg, Russia.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

An A-1 tool room foreman, excellent reputation, expert on tool and die work, thoroughly experienced in manufacturing by uptodate methods, would like to locate at once. Box 103, AMERICAN MACHINIST.

ILLINOIS

Foreman (32), single, having 16 years' experience as lathe hand, wishes charge of lathe department; salary $24; can reduce cost by labor saving devices. Box 102, AM. M.

Wanted—Position as superintendent or assistant, thoroughly conversant with piecework and uptodate methods of manufacture of interchangeable work; have had 18 years of general shop practice; A-1 organizer. Box 89, AMERICAN MACHINIST.

MASSACHUSETTS

A-1 production man, estimator, tool designer and speed boss. Box 100, AMER. MACH.

Assistant superintendent or general foreman; A-1 tool and machine designer; can get maximum output from equipment; age 34. Box 99, AMERICAN MACHINIST.

Responsible position wanted by a practical shop man, expert toolmaker and designer of special machinery and equipment, with wide experience. Box 58, AMERICAN MACHINIST.

Master mechanic, energetic, progressive and up to date, practical toolmaker and designer, experienced on accurate and interchangeable work; now employed but wishes change; best references as to ability and integrity. Box 80, AMERICAN MACHINIST.

MICHIGAN

Draftsman, with experience on automobile and motor parts, desires a change; would prefer position as checker or layout man; can furnish good references. Box 81, AM. MACH.

NEW JERSEY

Draftsman, experienced on jigs, fixtures, tools, also general shop and factory equipment, desires a position. Box 73, AM. MACH.

General foreman, 39, now engaged, accustomed to modern methods of manufacture, desires change. Box 61, AMERICAN MACHINIST.

Situation wanted as machine shop foreman with 25 years' experience, both light and heavy work; can furnish best of references. Box 118, AMERICAN MACHINIST.

Draftsman, familiar with automatic machine tool design, wants position in shipbuilding industry; can furnish references on previous occupations. Box 98, AM. MACH.

Cost accountant, eleven years' experience in machinery line, best references, wishes position or would like to communicate with firm erecting manufacturing plant. Box 96, AMERICAN MACHINIST.

Situation wanted as superintendent or factory manager; thoroughly conversant in foundry and machine shop, both light and heavy work; have had 20 years' experience; can give best of references. Box 117, AM. MA.

Wanted—Position as manager, or assistant manager of machine tool plant or machine shops, or would put experience against capital in a partnership; over 19 years' experience as machinist, toolmaker, foreman, inspector, demonstrator on road, estimator, designer, chief draftsman and assistant engineer; age 36; permanent position only considered; salary $2500; I can make good. Box 48, AM. M.

Young married man desires position; thoroughly understands costs and production, modern shop methods and store room systems; not an expert, but have the knowledge and the initiative that mean success; 10 years' experience; can furnish reference as to ability, etc.; the question of salary is open until I prove I am the man you are looking for. Address "A. V. R.," AMER. MACHINIST.

NEW YORK

Draftsman, experienced on tool designing; good mechanic. Box 111, AMER. MACHINIST.

Young German, general machine designer, desires position; experience; age 23; best references. Address E. Schramm, 36 Rutland Road, Brooklyn, N. Y.

Correspondence solicited with concern in need of services of engineer and designer; over twenty years' experience; has held positions of trust for many years. Box 112, AM. MACH.

First-class tool designer; thorough knowledge of modern shop and drafting room practice for manufacturing automobiles and interchangeable parts; can also take charge. Box 105, AMERICAN MACHINIST.

Mechanical engineer, expert mechanic, designer and shopman with quick comprehension, 14 years' experience in designing manufacturing and lay out of tools, increasing production in machine shops, foundry and manufacturing plant, desires position. Box 85, AMERICAN MACHINIST.

Superintendent and factory manager, high class, hustling and efficient; expert on tools, dies, gages, machine building interchangeable parts, foundry structural steel and sheet metal products; thoroughly understands handling help, hustling out work, speed and production my specialty; never failed to exceed all expectation; superintendent twelve years. Box 64, AMERICAN MACHINIST.

OHIO

Machine shop foreman desires change; good references. Box 32, AMERICAN MACHINIST.

PENNSYLVANIA

Designer, at present in responsible position, desires change. Box 106, AMER. MACH.

Tool or general foreman desires change; at present employed as such. Box 107, AM. M.

Cost accountant, thorough experience in machine shops and foundries, desires to change; references. Box 65, AMER. MACH.

Foreman, middle aged, now employed, latest methods, engineering, dynamos, electrical and general machinery; A-1 hustler; can handle force with executive ability. Box 87, AM. MA.

FOR SALE

For Sale—Patents of United States and foreign countries or interest in manufacturing company on coal distributing apparatus; first-class investment. "A. S.," AM. MACH.

For Sale—Acme automatic screw machines, practically new; over supply of one kind only reason for selling; condition guaranteed—One No. 51, ¼ inch; one No. 52, ⅜ inch; one No. 53, 1 inch; one No. 54, 1½ inches; write for prices. Box 93, AMERICAN MACHINIST.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

It was Gladstone who used to have a friend send him the American magazines every month.

But one day the friend, with a sudden rush of economy to the head, cut and tore and otherwise hacked out all the advertisements to save postage.

For he thought that the eminent English statesman could not possibly be interested in such a distinctly commercial subject as advertising.

But, in due course, Mr. Gladstone received the emasculated magazines.

And, still in due course, the friend in America received a letter from Mr. Gladstone, which said in effect: "The next time you cut anything out of the magazines do not cut out the advertising matter. For the advertisements interest me immensely."

Which shows, conclusively, the interest that one of the greatest men of the nineteenth century took in advertising.

* * *

This is the Twentieth Century. And advertising has increased wonderfully in interest (as well as other things) since Mr. Gladstone wrote his famous letter.

Some of you who have been reading the AMERICAN MACHINIST for fifteen, twenty or more years have probably noticed the difference in the advertising pages, as well as the reading pages of your paper.

Although the change in the advertising matter has not been vividly noticeable from issue to issue. It has been gradual.

Ten and fifteen years ago advertisements with an indistinct illustration, a death-notice border and an irrelevant remark were the rule.

Today such advertisements, alas, are still with us. But now they are the exception.

In outward form, advertising in general has undergone a tremendous change.

But not only in outward form. For in what might be called "inward form," in the ideas and the purpose behind advertising, has it also changed.

Advertising started out as an infant—a lot of trouble, a lot of noise, a lot of what might be termed politely "accidents"—and not much else.

It passed through the adolescent stage where it performed its share of damphoolishness. It has passed out of that stage—almost.

It is now well developed—honest, truthful and friendly. A friend of both seller and buyer. It brings them together to their mutual interest and profit.

Advertising has helped you a lot,—directly or unconsciously.

You have read advertisements which gave you some information you were seeking.

Or presented a new idea of value to you. Or told you of a product which saved you time or money.

Advertising has done this for *you* in greater or less degree.

How much greater this profit or advancement—call it what you will—could be multiplied and intensified, if you made it a practice to study the advertising pages systematically with this end in view.

The man who read the baseball score only once in a while didn't take much interest in it.

But the man who followed it every day and knew the standing of each team and Wagner's batting average and Cobb's base-running—

He got a heap of interest out of it. It's the same way with advertising.

The interest and the profit are there.

Gladstone found them.

And so can you.

* * *

Only reliable products can be continuously advertised.